OUTCOMES AND REIMBURSEMENT OF INPATIENT REHABILITATION SERVICES FOR MEDICARE BENEFICIARIES WITH STROKE AND HIP FRACTURE

ANNE FRANCES DEUTSCH

CMS Recd 6/25/03

OUTCOMES AND REIMBURSEMENT OF INPATIENT REHABILITATION SERVICES FOR MEDICARE BENEFICIARIES WITH STROKE AND HIP FRACTURE

by

Anne Frances Deutsch
May 1, 2003

A dissertation submitted to the
Faculty of the Graduate School of State
University of New York at Buffalo
in partial fulfillment of the requirements for the
degree of

Doctor of Philosophy

Department of Social and Preventive Medicine

Copyright by

Anne Frances Deutsch

2003

DEDICATION

To my husband Steve, my son Adam, and my parents Robert and Pam Griffiths.

ACKNOWLEDGEMENTS

This study was funded by the Centers for Medicare and Medicaid Services (CMS), under the Dissertation Grant Program, Grant number 30-P-30247/2-01. The project officer was Carl Hackerman.

I am very grateful to have obtained the input and guidance of a distinguished committee of experts for this study. Their generosity in sharing knowledge and wisdom and their encouragement were invaluable. These scholars contributed greatly to this study and made it a great learning experience: Dr. Maurizio Trevisan, Dr. John Naughton, Dr. Carl Granger, and Dr. Roger Fiedler

I also greatly appreciate the insights and expertise shared by: Dr. Kenneth Ottenbacher from the University of Texas Medical Branch at Galveston, the outside reader for this study; Dr. Gerben DeJong from the University of Florida, a consultant for the study; and Dr. Robert Kane, from the University of Minnesota, also a consultant for the study.

In addition, I must thank the many people at CMS who assisted me with this project and its complex Medicare issues, including Carl Hackerman, Caroline

Rimes, Pete Diaz, and Dinah Horton. Kelly Merriman from the Research Data Assistance Center (ResDAC) and Mike Hadad also provided a great deal of assistance in understanding the Medicare data. Thanks are also due to Dr. Malcolm Morrison and Dr. Korbin Lui for assistance.

Throughout this effort I received valuable assistance and support from Carol Russell, Dr. Richard Linn, Joan Buchanan, Vinnie Thompson and Peggy Kulas.

The contribution of a number of information technology “wizards” helped pull the study together and successfully transformed a large number of data tapes into useable research data, including: Reb Carter, Dr. Martin Camacho, Pawel Wieczorek, Bonnie Trunzo, and the staff of UB’s Computer Help Desk.

Throughout this project I have received support and assistance from Marcia Wopperer, Heidi Kuwik, Cindy Geary and JoMarie Woltz.

I also want to thank the many clinicians who collected the FIM data that were used in this study.

TABLE OF CONTENTS

ABBREVIATIONS XIII

FIGURES XIV

TABLES XV

ABSTRACT XXXVII

CHAPTER 1: INTRODUCTION AND RESEARCH QUESTIONS 1

Introduction and Significance 1

Problem Statement 3

Research Questions: Patients with Hip Fractures 4

Research Questions: Patients with Stroke 5

CHAPTER 2: REVIEW OF THE LITERATURE 6

Medical Rehabilitation Services 6

Definition of Rehabilitation Services 6

Inpatient Rehabilitation Facilities (IRFs): Definition, Medicare Certification Requirements and Coverage 7

Skilled Nursing Facilities (SNFs): Definition, Medicare Certification Requirements and Coverage 10

Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Respond to the Acute Care Prospective Payment System 12

Utilization and Medicare Expenditures for Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) 15

Factors Associated with Utilization of Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) 18

Patient Factors Related to Use of Post Acute Care *18*

Market Factors Associated with Use of Post Acute Care *19*

The Costs of Treatment in Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) 21

Outcomes of Rehabilitation Care for Patients with Hip Fracture and Patients with Stroke 21

Hip Fracture *22*

Stroke *25*

Market Characteristics That May Influence Functional Outcomes 28

Clinical Outcomes and Cost of Rehabilitation Care Provided in Inpatient Rehabilitation Facilities and Skilled Nursing Facilities 29

CHAPTER 3: METHODOLOGY 38

Study Sample 38

Primary Data Sources 41

Overview of Centers for Medicare and Medicaid Services (CMS) and CMS Data *41*

TABLE OF CONTENTS (CONT'D)

Overview of the Uniform Data System for Medical Rehabilitation (UDSMR) and UDSMR Data 45

Other Data Sources 51

Area Resource File Data 51

MapInfo 51

Record Linkage 52

Introduction 52

Record Linkage: Background and Terminology 53

Linking UDSMR and MedPAR Patient Records 54

Selection of Patient Records from MedPAR Files 55

Selection of Patient Records from UDSMR Files 57

Merging Records Using Linkage Variables 58

Data Cleaning 69

Variable Definitions 69

Dependent Variables 69

Independent Variable 71

Covariates 71

Stratification Variable: Case-Mix Groups 80

Statistical Analyses 81

TABLE OF CONTENTS (CONT'D)

CHAPTER 4: RESULTS 89

Results from the 1996 Hip Fracture Database 89

Application of the Exclusion Criteria – 1996 Hip Fracture Database 89

Patient Characteristics – 1996 Hip Fracture Database 90

Reliability of FIM Ratings – 1996 Hip Fracture Database 97

Facility-Level Market Characteristics – 1996 Hip Fracture Database 98

Research Question 1: Did the Percentage of Patients with Hip Fracture Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1996? 101

Research Question 2: Did the Functional Outcomes of Patients with Hip Fracture Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1996? 114

Research Question 3: Did Medicare Payments for Patients with Hip Fracture Treated in IRFs Differ from Medicare Payments for Patients Treated in SNF-Based Rehabilitation Care Across All Case-Mix Groups in 1996? 127

Results – 1997 Hip Fracture Database 134

Application of Exclusion Criteria -- 1997 Hip Fracture Database 134

Patient Characteristics – 1997 Hip Fracture Database 136

Reliability of FIM Ratings – 1997 Hip Fracture Database 141

Facility-Level Market Characteristics – 1997 Hip Fracture Database 142

TABLE OF CONTENTS (CONT'D)

Research Question 2: Did the Functional Outcomes of Patients with Hip Fracture Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1997? *157*

Research Question 3: Did Medicare Payments for Patients with Hip Fracture Treated in IRFs Differ from Medicare Payments for Patients Treated in SNF-Based Rehabilitation Care across all Case-Mix Groups in 1997? *168*

Results from the Combined 1996 and 1997 Hip Fracture Databases 175

Research Question 1: Did the Percentage of Patients with Hip Fracture Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1996 and 1997? *175*

Research Question 2: Did the Functional Outcomes of Patients with Hip Fracture Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1996 and 1997? *184*

Research Question 3: Did Medicare Payments for Patients with Hip Fracture Treated in IRFs Differ from Medicare Payments for Patients Treated in SNF-Based Rehabilitation Care Across All Case-Mix Groups in 1996 and 1997? *193*

Results – 1996 Stroke Database 200

Application of Exclusion Criteria – 1996 Stroke Database *200*

Patient Characteristics – 1996 Stroke Database *201*

Reliability of FIM Ratings – 1996 Stroke Database *208*

Facility-Level Market Characteristics – 1996 Stroke Database 208
Research Question 4: Did the Percentage of Patients with Stroke Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1996? 211
Research Question 5: Did the Functional Outcomes of Patients with Stroke Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1996? 224
Research Question 6: Did Medicare Payments for Patients with Stroke Treated in IRFs Differ from Medicare Payments for Patient Treated in SNF-Based Rehabilitation Care across all Case-Mix Groups in 1996? 235
Results – 1997 Stroke Database 242
Application of Exclusion Criteria – 1997 Stroke Database 242
Patient Characteristics – 1997 Stroke Database 244
Reliability of FIM Ratings – 1997 Stroke Database 249
Facility-Level Market Characteristics – 1997 Stroke Database 250
Research Question 4: Did the Percentage of Patients with Stroke Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1997? 253
Research Question 5: Did the Functional Outcomes of Patients with Stroke Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1997? 266

TABLE OF CONTENTS (CONT'D)

Research Question 6: Did Medicare Payments for Patients with Stroke Treated in IRFs Differ from Medicare Payments for Patients Treated in SNF-Based Rehabilitation Care across all Case-Mix Groups in 1997? *278*

Results from the Combined 1996 and 1997 Stroke Databases 284

Research Question 4: Did the Percentage of Patients with Stroke Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1996 and 1997? *284*

Research Question 5: Did the Functional Outcomes of Patients with Stroke Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1996 and 1997? *293*

Research Question 6: Did Medicare Payments for Patients with Stroke Treated in IRFs Differ from Medicare Payments for Patients Treated in SNF-Based Rehabilitation Care across all Case-Mix Groups in 1996 and 1997? *301*

CHAPTER 5: DISCUSSION 308

Overview of Significant Findings 308

Characteristics of Patients Treated in Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) 313

Consideration of Findings Given Existing Research – Hip Fracture 314

Consideration of Findings Given Existing Research – Stroke 316

Strengths and Limitations 317

TABLE OF CONTENTS (CONT'D)

Suggestions for Further Research.......323

Implications for Practice.......325

Summary.......328

REFERENCES.......329

APPENDIX A: GLOSSARY OF TERMS

APPENDIX B: UDSMR CODING SHEET

APPENDIX C: LINKAGE THEORY

APPENDIX D: LINKAGE TABLES

APPENDIX E: PROCEDURES USED TO STANDARDIZE MEDICARE PAYMENT

APPENDIX F: COVARIATES

APPENDIX G: PROCEDURES USED TO ASSESS FOR POTENTIAL BIAS DUE TO METHODOLOGY

APPENDIX H: PROCEDURES USED TO ASSESS FOR POTENTIAL BIAS DUE TO EXCLUSION CRITERIA

ABBREVIATIONS

ADL	Activities of Daily Living
ANCOVA	Analysis of Covariance
ARF	Area Resource File
CARF	Commission on Accreditation of Rehabilitation Facilities
CMG	Case-Mix Group
CMS	Centers for Medicare and Medicaid Services
DRG	Diagnosis Related Group
FIM	Functional Independence Measure
ICD-9-CM	International Classification Of Diseases 9th Revision, Clinical Modification
IRF	Inpatient Rehabilitation Facilities
JCAHO	Joint Commission On Accreditation of Healthcare Organizations
LOS	Length of Stay
MedPAR	Medicare Provider Analysis and Review
PPS	Prospective Payment System
RUGs	Resource Utilization Groups
SNF	Skilled Nursing Facilities
SPSS	Statistical Program for the Social Sciences
UDSMR	Uniform Data System for Medical Rehabilitation
ZIP	Zone Improvement Planning (code)

FIGURES

Figure 3.1 Process of Merging Data Files 63

Figure 4.1 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Inpatient Rehabilitation Facilities, 1996 Hip Fracture. 92

Figure 4.2 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Skilled Nursing Facilities, 1996 Hip Fracture 93

Figure 4.3 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Inpatient Rehabilitation Facilities, 1997 Hip Fracture 137

Figure 4.4 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Skilled Nursing Facilities, 1997 Hip Fracture 138

Figure 4.5 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Inpatient Rehabilitation Facilities, 1996 Stroke 203

Figure 4.6 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Skilled Nursing Facilities, 1996 Stroke 204

Figure 4.7 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Inpatient Rehabilitation Facilities, 1997 Stroke 245

Figure 4.8 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Skilled Nursing Facilities, 1997 Stroke 246

Figure C.1 Comparison of Record Linkage Terms with Screening Test Results C-2

TABLES

Table 2.1 Medicare Requirements for Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) in 1996/1997 8

Table 2.2 The Number of Medicare-Certified Inpatient Rehabilitation Facilities and Skilled Nursing Facilities: 1985, 1990, 1992, 1994, 1996. 15

Table 2.3 Estimated Medicare Payments and Discharges for IRFs and SNFs, Fiscal Years 1986 – 1994. 16

Table 3.1 Study Exclusion Criteria and Rationale 40

Table 3.2 Percent of MedPAR and UDSMR records linked by Rehabilitation Setting and Year, 1996 and 1997 Hip Fracture Databases 67

Table 3.3 Percent of MedPAR and UDSMR records linked by Rehabilitation Setting and Year, 1996 and 1997 Stroke Databases 68

Table 3.4 Summary of Dependent and Independent Variables 72

Table 3.5 Valid Codes, Outlier Definitions, and Treatment of Missing and Invalid Values for Dependent Variables, Independent Variables and Covariates. 74

Table 3.6 Case-Mix Group Definitions for IRF-PPS and for this Study 82

Table 4.1 Number and Percent of Records of Patients with Hip Fracture not Included in Analysis by Exclusion Criteria for All Cases and by Rehabilitation Setting, 1996. (n = 17,012) 91

Table 4.2 Sociodemographic, Medical and Hospitalization Characteristics of Patients with Hip Fracture, 1996 (n = 14,457) 94

Table 4.3 Cronbach's Alpha for FIM Data by Rehabilitation Setting, Patients with Hip Fracture, 1996 (n = 14,457) 98

Table 4.4 Characteristics of Facilities by Type of Rehabilitation Setting, Patients with Hip Fracture, 1996 (n = 612 facilities) 99

Table 4.5 Unadjusted Percent of Patients with Hip Fracture Discharged to Community-Based Settings by Rehabilitation Setting, 1996 (n = 14,457) 104

TABLES (CONT'D)

Table 4.6 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger, 1996 Hip Fracture Database (n = 5,335) 106

Table 4.7 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older, 1996 Hip Fracture Database (n = 3,287) ... 107

Table 4.8 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger, 1996 Hip Fracture Database (n = 2,791) 108

Table 4.9 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disabilities (Case-Mix Groups 704 and 705) and 83 Years of Age or Older, 1996 Hip Fracture Database (n = 3,044) 109

Table 4.10 Post-Hoc Power Estimates for Logistic Regression Analyses, 1996 Hip Fracture Database (n = 14,457) 111

Table 4.11 Unadjusted Mean, Standard Deviation, and Median Discharge Motor FIM Ratings of Patients with Hip Fractures by Group, 1996 (n = 14,457) 117

Table 4.12 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger, 1996 Hip Fracture Database (n = 5,335) 120

Table 4.13 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older, 1996 Hip Fracture Database (n = 3,287) ... 121

Table 4.14 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger, 1996 Hip Fracture Database (n = 2,791) 122

TABLES (CONT'D)

Table 4.15 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older, 1996 Hip Fracture Database (n = 3,044) 123

Table 4.16 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1996 Hip Fracture Database (n = 14,457) 124

Table 4.17 Medicare Part A Payment Data for Fee-for-Service Patients with Hip Fracture by Rehabilitation Setting, 1996 (n = 14,457) 129

Table 4.18 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Hip Fracture by Case-Mix Group and by Rehabilitation Setting, 1996 (n = 14,457) 130

Table 4.19 Number and Percent of Records of Patients with Hip Fracture not Included in Analyses by Exclusion Criteria for All Cases and by Rehabilitation Setting, 1997 (n = 18,442) 135

Table 4.20 Sociodemographic and Hospitalization Characteristics of Patients with Hip Fracture by Rehabilitation Setting, 1997 (n = 15,336) 139

Table 4.21 Cronbach's Alpha for FIM Data, Patients with Hip Fracture, 1997 (n = 15,336) 142

Table 4.22 Characteristics of Facilities by Rehabilitation Setting, Patients with Hip Fracture, 1997 (n = 688 Facilities) 143

Table 4.23 Unadjusted Percent of Patients with Hip Fracture Discharged to Community-Based Settings by Rehabilitation Setting, 1997 (n = 15,336) 148

Table 4.24 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disabilities (Case-Mix Groups 701, 702 and 703) and 82 Years Old or Younger, 1997 Hip Fracture Database (n = 5,277) 150

Table 4.25 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disabilities (Case-Mix Groups 701, 702 and 703) and 83 Years Old or Older, 1997 Hip Fracture Database (n = 3,452) 151

TABLES (CONT'D)

Table 4.26 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disabilities (Case-Mix Groups 704 and 705) and 82 Years Old or Younger, 1997 Hip Fracture Database (n = 3,090) 152

Table 4.27 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disabilities (Case-Mix Groups 704 and 705) and 83 Years or Older, 1997 Hip Fracture Database (n =3,517).. 153

Table 4.28 Post-Hoc Power Estimates for Logistic Regression Analyses, 1997 Hip Fracture Database (n = 15,336).. 154

Table 4.29 Unadjusted Mean, Standard Deviation, and Median Discharge Motor FIM Ratings of Patients with Hip Fractures by Group, 1997 (n = 15,336).. 159

Table 4.30 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger, 1997 Hip Fracture Database (n = 5,277) 161

Table 4.31 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older, 1997 Hip Fracture Database (n = 3,452) ... 162

Table 4.32 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger, 1997 Hip Fracture Database (n = 3,090) 163

Table 4.33 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older, 1997 Hip Fracture Database (n = 3,517) 164

Table 4.34 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1997 Hip Fracture Database (n = 15,336)..................................... 165

Table 4.35 Medicare Part A Payment Data for Fee-for-Service Patients with Hip Fracture by Rehabilitation Setting, 1997 (n = 15,336).................... 170

TABLES (CONT'D)

Table 4.36 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Hip Fracture by Case-Mix Group and by Rehabilitation Setting, 1997 (n = 15,336) 172

Table 4.37 Unadjusted Percent of Patients with Hip Fracture Discharged to Community-Based Settings by Rehabilitation Setting, 1996 and 1997 (n = 29,793) 177

Table 4.38 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger, Combined 1996 and 1997 Hip Fracture Databases (n = 10,612) 179

Table 4.39 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older, Combined 1996 and 1997 Hip Fracture Databases (n = 6,739) 180

Table 4.40 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger, Combined 1996 and 1997 Hip Fracture Databases (n = 5,881) 181

Table 4.41 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disabilities (Case-Mix Groups 704 and 705) and 83 Years of Age or Older, Combined 1996 and 1997 Hip Fracture Databases (n = 6,561) 182

Table 4.42 Post-Hoc Power Estimates for Logistic Regression Analyses, 1996 and 1997 Hip Fracture Databases (n = 29,793) 183

Table 4.43 Unadjusted Mean, Standard Deviation, and Median Discharge Motor FIM Ratings of Patients with Hip Fractures by Group, 1996 and 1997 (n = 29,793) 186

TABLES (CONT'D)

Table 4.44 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger, Combined 1996 and 1997 Hip Fracture Databases (n = 10,612)....188

Table 4.45 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older, Combined 1996 and 1997 Hip Fracture Databases (n = 6,739)....189

Table 4.46 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger, Combined 1996 and 1997 Hip Fracture Databases (n = 5,881)....190

Table 4.47 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older, Combined 1996 and 1997 Hip Fracture Databases (n = 6,561) 191

Table 4.48 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1996 and 1997 Hip Fracture Databases (n = 29,793)....192

Table 4.49 Medicare Part A Payment Data for Fee-for-Service Patients with Hip Fracture by Rehabilitation Setting, 1996 and 1997 (n = 29,793)....194

Table 4.50 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Hip Fracture by Case-Mix Group and by Rehabilitation Setting, 1996 and 1997 (n = 29,793)....197

Table 4.51 Number and Percent of Records of Patients with Stroke Excluded from Analyses for All Cases and by Rehabilitation Setting, 1996. (n = 37,174)....202

Table 4.52 Sociodemographic and Hospitalization Characteristics of Patients with Stroke by Rehabilitation Setting, 1996 (n = 30,345)....205

Table 4.53 Cronbach's Alpha for FIM Data, Patients with Stroke, 1996 (n = 30,345)....208

TABLES (CONT'D)

Table 4.54 Characteristics of Facilities by Rehabilitation Setting, Patients with Stroke, 1996 (n = 718 Facilities) 209

Table 4.55 Unadjusted Percent of Patients with Stroke Discharged to Community-Based Settings by Rehabilitation Setting, 1996 (n = 30,345) 214

Table 4.56 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 101 to 107 and 77 Years of Age or Younger, 1996 (n = 9,346) 216

Table 4.57 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 101 to 107 and 78 Years of Age or Older, 1996 (n = 7,175) 217

Table 4.58 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 77 Years Old or Younger, 1996 (n = 7,466) 218

Table 4.59 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 78 Years of Age or Older, 1996 (n = 6,358) 219

Table 4.60 Post-Hoc Power Estimates for Logistic Regression Analyses, 1996 Stroke Database (n = 30,345) 220

Table 4.61 Unadjusted Mean, Standard Deviation, and Median Discharge Motor FIM Ratings of Patients with Stroke by Group, 1996 (n = 30,345). 226

Table 4.62 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger, 1996 Stroke Database (n = 9,346) 228

Table 4.63 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older, 1996 Stroke Database (n = 7,175) 229

TABLES (CONT'D)

Table 4.64 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger, 1996 Stroke Database (n = 7,466)..............................230

Table 4.65 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older, 1996 Stroke Database (n = 6,358) 231

Table 4.66 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1996 Stroke Database (n = 30,345) 232

Table 4.67 Medicare Part A Payment Data for Fee-for-Service Patients with Stroke by Rehabilitation Setting, 1996 (n = 30,345).......................237

Table 4.68 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Stroke by Case-Mix Group and by Rehabilitation Setting, 1996 (n = 30,345) 239

Table 4.69 Number and Percent of Records of Patients with Stroke Not Included in Analyses by Exclusion Criteria for All Cases and by Rehabilitation Setting, 1997 (n = 35,579)..243

Table 4.70 Demographic and Hospitalization Characteristics of Patients with Stroke by Rehabilitation Setting, 1997 (n = 28,379).......................247

Table 4.71 Cronbach's Alpha for FIM Data, Patients with Stroke, 1997 (n= 28,379)...250

Table 4.72 Characteristics of Facilities by Rehabilitation Setting, Patients with Stroke, 1997 (n = 812 facilities)...251

Table 4.73 Unadjusted Percent of Patients with Stroke Discharged to Community-Based Settings by Rehabilitation Setting, 1997 (n = 28,379)...256

Table 4.74 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger, 1997 (n = 8,552)..258

TABLES (CONT'D)

Table 4.75 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 101 to 107 and 78 Years of Age or Older, 1997 (n = 6,930) 259

Table 4.76 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 77 Years of Age or Younger, 1997 (n = 6,623) 260

Table 4.77 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 78 Years of Age or Older, 1997 (n = 6,274) 261

Table 4.78 Post-Hoc Power Estimates for Logistic Regression Analyses, 1997 Stroke Database (n = 28,379) 262

Table 4.79 Unadjusted Mean, Standard Deviation, and Median Motor FIM Ratings of Patients with Stroke by Group, 1997 (n = 28,379) 268

Table 4.80 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 years of Age or Younger, 1997 Stroke Database (n = 8,552) 270

Table 4.81 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older, 1997 Stroke Database (n = 6,930) 271

Table 4.82 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger, 1997 Stroke Database (n = 6,623) 272

Table 4.83 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Moderate to Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older, 1997 Stroke Database (n = 6,274) 273

Table 4.84 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1997 Stroke Database (n = 28,379) 275

TABLES (CONT'D)

Table 4.85 Medicare Part A Payment Data for Fee-for-Service Patients with Stroke by Rehabilitation Setting, 1997 (n = 28,379) 279

Table 4.86 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Stroke by Case-Mix Group and by Rehabilitation Setting, 1997 (n = 28,379) 281

Table 4.87 Unadjusted Percent of Patients with Stroke Discharged to Community-Based Settings by Rehabilitation Setting, 1996 and 1997 (n = 58,724) 286

Table 4.88 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger, 1996 and 1997 (n = 17,898) 287

Table 4.89 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 101 to 107 and 78 Years of Age or Older, 1996 and 1997 (n = 14,105) 288

Table 4.90 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 77 Years of Age or Younger, 1996 and 1997 (n = 14,089) 289

Table 4.91 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 78 Years of Age or Older, 1996 and 1997 (n = 12,632) 290

Table 4.92 Post-Hoc Power Estimates for Logistic Regression Analyses, 1996 and 1997 Stroke Databases (n = 58,724) 292

Table 4.93 Unadjusted Mean, Standard Deviation, and Median Discharge Motor FIM Ratings of Patients with Stroke by Group, 1996 and 1997 (n = 58,724) 294

Table 4.94 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 years of Age or Younger, 1996 and 1997 Stroke Databases (n = 17,898) ..296

TABLES (CONT'D)

Table 4.95 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older, 1996 and 1997 Stroke Databases (n = 14,105) 297

Table 4.96 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger, 1996 and 1997 Stroke Databases (n=14,089)..298

Table 4.97 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Moderate to Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older, 1996 and 1997 Stroke Databases (n = 12,632) 299

Table 4.98 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1996 and 1997 Stroke Databases (n = 58,724) 301

Table 4.99 Medicare Part A Payment Data for Fee-for-Service Patients with Stroke by Rehabilitation Setting, Combined 1996 and 1997 Databases (n = 58,724) 302

Table 4.100 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Stroke by Case-Mix Group and by Rehabilitation Setting, Combined 1996 and 1997 Databases (n = 58,724) 305

Table 5.1 Summary of Regression Estimates of Effect of Rehabilitation Setting, Patients with Hip Fracture, 1996 and 1997 309

Table 5.2 Summary of Regression Estimates of Effect of Rehabilitation Setting, Patients with Stroke, 1996 and 1997 311

Table C.1 Comparison of Terminology Used in Linkage Theory and for Screening Tests C-1

Table D.1 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1996 .... D-1

TABLES (CONT'D)

Table D.2 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1996 . D-2

Table D.3 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1996 . D-3

Table D.4 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1996 .... D-4

Table D.5 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1996 .... D-4

Table D.6 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1996 .... D-5

Table D.7 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1996 .... D-6

Table D.8 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1996 .... D-7

Table D.9 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1996 .... D-8

TABLES (CONT'D)

Table D.10 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1996 .... D-8

Table D.11 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1997........ D-9

Table D.12 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1997.... .... D-10

Table D.13 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1997 ....D-11

Table D.14 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1997.......... D-12

Table D.15 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1997.......... D-12

Table D.16 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1997 .... D-13

Table D.17 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1997.......... D-14

TABLES (CONT'D)

Table D.18 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1997 .... D-15

Table D.19 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1997 .... D-16

Table D.20 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1997 .... D-16

Table D.21 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1996 .... D-17

Table D.22 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1996 .... D-18

Table D.23 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1996 .... D-19

Table D.24 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1996 .... D-20

Table D.25 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1996 .... D-20

TABLES (CONT'D)

Table D.26 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1996 .... D-21

Table D.27 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1996 .... D-22

Table D.28 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1996 .... D-23

Table D.29 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Skilled Nursing Facilities in 1996 .... D-24

Table D.30 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Skilled Nursing Facilities in 1996 .... D-24

Table D.31 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1997 .... D-25

Table D.32 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1997......... D-26

Table D.33 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1997......... D-27

TABLES (CONT'D)

Table D.34 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1997 .... D-28

Table D.35 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1997 .... D-28

Table D.36 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1997 .... D-29

Table D.37 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1997 .... D-30

Table D.38 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1997 .... D-31

Table D.39 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Skilled Nursing Facilities in 1997 .... D-32

Table D.40 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Skilled Nursing Facilities in 1997 .... D-32

Table F.1 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger (Group 1), 1996 Hip Fracture Database (n = 5,335).... F-4

TABLES (CONT'D)

Table F.2 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older (Group 2), 1996 Hip Fracture Database (n = 3,287)......... F-5

Table F.3 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger (Group 3), 1996 Hip Fracture Database (n = 2,791) F-6

Table F.4 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older (Group 4), 1996 Hip Fracture Database (n = 3,044) F-7

Table F.5 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger (Group 1), 1997 Hip Fracture Database (n = 5,277).... F-8

Table F.6 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older (Group 2), 1997 Hip Fracture Database (n = 3,452)......... F-9

Table F.7 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger (Group 3), 1997 Hip Fracture Database (n = 3,090) F-10

Table F.8 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older (Group 4), 1997 Hip Fracture Database (n = 3,517) F-11

Table F.9 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger (Group 1), 1996 Hip Fracture Database (n = 5,335).. F-14

TABLES (CONT'D)

Table F.10 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older (Group 2), 1996 Hip Fracture Database (n = 3,287) F-15

Table F.11 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger (Group 3), 1996 Hip Fracture Database (n = 2,791) F-16

Table F.12 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older (Group 4), 1996 Hip Fracture Database (n = 3,044) F-17

Table F.13 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger (Group 1), 1997 Hip Fracture Database (n = 5,277) F-18

Table F.14 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older (Group 2), 1997 Hip Fracture Database (n = 3,452) F-19

Table F.15 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger (Group 3), 1997 Hip Fracture Database (n = 3,090) F-20

Table F.16 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older (Group 4), 1997 Hip Fracture Database (n = 3,517) F-21

Table F.17 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger (Group 1), 1996 Stroke Database (n = 9,346) F-24

TABLES (CONT'D)

Table F.18 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older (Group 2), 1996 Stroke Database (n = 7,175) F-25

Table F.19 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger (Group 3), 1996 Stroke Database (n = 7,466) F-26

Table F.20 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older (Group 4), 1996 Stroke Database (n = 6,358)....................................F-27

Table F.21 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger (Group 1), 1997 Stroke Database (n = 8,552) F-28

Table F.22 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older (Group 2), 1997 Stroke Database (n = 6,930) F-29

Table F.23 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger (Group 3), 1997 Stroke Database (n = 6,623) F-30

Table F.24 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older (Group 4), 1997 Stroke Database (n = 6,274) F-31

Table F.25 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 108) and 77 Years of Age or Younger (Group 1), 1996 Stroke Database (n = 9,346). F-35

TABLES (CONT'D)

Table F.26 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 108) and 78 Years of Age or Older (Group 2), 1996 Stroke Database (n = 7,175)......... F-36

Table F.27 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 109 to 114) and 77 Years of Age or Younger (Group 3), 1996 Stroke Database (n = 7,466) F-37

Table F.28 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older (Group 4), 1996 Stroke Database (n = 6,358) F-38

Table F.29 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger (Group 1), 1997 Stroke Database (n = 8,552).... F-39

Table F.30 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older (Group 2), 1997 Stroke Database (n = 6,930)......... F-40

Table F.31 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger (Group 3), 1997 Stroke Database (n = 6,623) F-41

Table F.32 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older (Group 4), 1997 Stroke Database (n = 6,274)......... F-42

Table G.1 Logistic Regression Estimates of Effect of Rehabilitation Setting on Likelihood of Community-Based Discharge for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Hip Fracture, 1996 ....G-6

TABLES (CONT'D)

Table G.2 Multiple Linear Regression Estimates of Effect of Rehabilitation Setting on Discharge Motor FIM Ratings for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Hip Fracture, 1996 .... G-7

Table G.3 Logistic Regression Estimates of Effect of Rehabilitation Setting on Likelihood of Community-Based Discharge for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Hip Fracture, 1997 .... G-8

Table G.4 Multiple Linear Regression Estimates of Effect of Rehabilitation Setting on Discharge Motor FIM Ratings for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Hip Fracture, 1997 .... G-9

Table G.5 Logistic Regression Estimates of Effect of Rehabilitation Setting on Likelihood of Community-Based Discharge for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Stroke, 1996 .. G-10

Table G.6 Multiple Linear Regression Estimates of Effect of Rehabilitation Setting on Discharge Motor FIM Ratings for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Stroke, 1996 .. G-11

Table G.7 Logistic Regression Estimates of Effect of Rehabilitation Setting on Likelihood of Community-Based Discharge for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Stroke, 1997 .. G-12

Table G.8 Multiple Linear Regression Estimates of Effect of Rehabilitation Setting on Discharge Motor FIM Ratings for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Stroke, 1997 .. G-13

Table H.1 Logistic Regression Estimates of Effects of Rehabilitation Setting on Likelihood of Community-Based Discharge for Various Exclusion Criteria, Patients with Hip Fracture, 1996 .... H-9

Table H.2 Multiple Linear Regression Estimates of Effects of Rehabilitation Setting on Discharge Motor FIM Ratings for Various Exclusion Criteria, Patients with Hip Fracture, 1996 .... H-10

Table H.3 Logistic Regression Estimates of Effects of Rehabilitation Setting on Likelihood of Community-Based Discharge for Various Exclusion Criteria, Patients with Hip Fracture, 1997 .... H-11

TABLES (CONT'D)

Table H.4 Multiple Linear Regression Estimates of Effects of Rehabilitation Setting on Discharge Motor FIM Ratings for Various Exclusion Criteria, Patients with Hip Fracture, 1997 .... H-12

Table H.5 Logistic Regression Estimates of Effects of Rehabilitation Setting on Likelihood of Community-Based Discharge for Various Exclusion Criteria, Patients with Stroke, 1996 .... H-13

Table H.6 Multiple Linear Regression Estimates of Effects of Rehabilitation Setting on Discharge Motor FIM Ratings for Various Exclusion Criteria, Patients with Stroke, 1996 .... H-14

Table H.7 Logistic Regression Estimates of Effects of Rehabilitation Setting on Likelihood of Community-Based Discharge for Various Exclusion Criteria, Patients with Stroke, 1997 .... H-15

Table H.8 Multiple Linear Regression Estimates of Effects of Rehabilitation Setting on Discharge Motor FIM Ratings for Various Exclusion Criteria, Patients with Stroke, 1997 .... H-16

ABSTRACT

Objective: To assess whether outcomes and reimbursement differ for Medicare beneficiaries with a stroke or hip fracture when treated in an inpatient rehabilitation facility (IRF) versus a skilled nursing facility (SNF) based rehabilitation program.

Design: Retrospective cohort study in which patients' clinical outcome data and Medicare payment data were linked.

Participants: The study included 29,793 Medicare beneficiaries with a hip fracture and 58,724 beneficiaries with a stroke who were treated in 1996 or 1997 in a rehabilitation facility that subscribed to the Uniform Data System for Medical Rehabilitation.

Outcomes Measures: Discharge destination following the rehabilitation stay and discharge motor Functional Independence Measure (FIM) ratings after adjustment for various patient- and facility-level characteristics; Medicare Part A reimbursement stratified by Case-Mix Group (CMG).

Results: Among older patients with hip fracture in CMGs 701 to 703 and all patients in CMGs 704 and 705, those treated in IRFs were less likely to return to the community. Adjusted odds ratios ranged from 0.73 (95% CI: 0.63 to 0.84) to 0.82 (95% CI: 0.68 to 0.98). For younger patients in CMGs 701 to 703, the

percent of patients discharged to the community was not different. Discharge functional status for patients with hip fracture was not clinically different. Across all CMGs, the IRF Medicare payments were higher than SNF payments by 54 to 73 percent.

For all patients with stroke in CMGs 101 to 107, and younger patients in CMGs 108 to 114, those treated in IRFs were more likely to return to the community. Adjusted odds ratios ranged from 1.42 (95% CI: 1.15 to 1.74) to 1.61 (95% CI: 1.22 to 2.11). The functional status of patients in CMGs 101 to 107 was not clinically different, but for patients in CMGs 108 to 114, those treated in IRFs achieved more independence by discharge. Across all CMGs, the IRF Medicare payments were higher than SNF payments by 79 to 117 percent.

Conclusion: Patients with hip fracture achieved equal or better outcomes in SNF-based rehabilitation programs at a lower cost. Patients with stroke achieved better outcomes when treated in IRFs at a higher cost.

CHAPTER 1: INTRODUCTION AND RESEARCH QUESTIONS

Introduction and Significance

In 1984, in an effort to control health care spending in the Medicare program, a prospective payment system for short-stay (i.e., acute care) hospitals was implemented based on the Diagnosis Related Group (DRG) classification system.[1] The DRG system provided strong incentives for these hospitals to discharge patients as soon as possible. Consequently, following the implementation of the DRG system, the average length of stay for patients in short-stay hospitals decreased. Patients were discharged from acute care hospitals quicker and sicker,[1-3] and many of these patients, some of whom required rehabilitation services, received additional care in post acute care settings.

Inpatient post acute care settings that provide rehabilitation services include inpatient rehabilitation facilities (IRFs), and some skilled nursing facilities (SNFs).

IRFs responded to the DRG-related changes by starting to admit patients with non-traditional rehabilitation diagnoses,[4, 5] as well as admitting a higher percentage of patients with traditional rehabilitation diagnoses from short-stay hospitals.[6] Some SNFs reacted to the increased needs of patients by beginning to specialize in providing increased rehabilitation therapy services, and referred

to their programs as “subacute rehabilitation” (see Appendix A: Glossary of Terms for definition of subacute rehabilitation).[7, 8] These changes reduced the distinctions between IRFs and SNFs.

Prior to the mid 1980s, care provided in post acute care settings, including IRFs and SNFs, represented a small percentage of total Medicare expenditures, and was considered a cost-effective alternative to extended acute care hospital stays.[9] In the early 1990s, care in these settings was the fastest growing area of the Medicare program. Between 1986 and 1994, Medicare payments to IRFs increased almost five-fold from $800 million to $3.9 billion, and payments to SNFs increased almost 12-fold from $500 million to $5.9 billion.[10]

The rapid increase in Medicare payments to post acute care providers led health policy analysts and health services researchers[11] to ask questions about the most appropriate use of post acute care. These questions included:

1) What factors are associated with receipt of different types of post acute care?
2) What are the costs associated with care in the different post acute care settings?
3) Do patient outcomes vary across the different post acute care settings, after adjusting for covariates?

In answering the first question, researchers found that both patient- and market-related factors were associated with use of post acute care. Patient-related

factors included a patient's medical diagnosis, functional status, and age.[11, 12] The medical conditions that most commonly led to post acute care admissions were stroke and hip procedures.

Market-related factors that were associated with use of post acute care included geographic region,[11, 13] availability of facilities,[14] managed care health insurance,[15] and hospital ownership of a post acute care setting.[16]

Analyses of financial data have found that care in IRFs was more costly than care in SNFs, but only a few investigations[7, 17, 18] have compared the outcomes of care for patients with stroke and hip fracture receiving care in IRFs and SNF-based rehabilitation programs.

Problem Statement

Care provided in IRFs and SNF-based rehabilitation programs has evolved since the mid-1980s, and the most appropriate use of these rehabilitation settings is unclear. There is only limited evidence that compares the effectiveness and costs of care in an IRF versus SNF-based rehabilitation program for persons with either a stroke or hip fracture. Studies by Kane,[7] Keith,[17] and Kramer[18] were limited by sample sizes, and as a result, investigators were restricted in their ability to study subgroups of patients based on the severity of their disabilities. These studies also relied on data collected between 1988 and 1994, when SNF-

based rehabilitation care was in its formative stages. It is not clear whether data from this early time period would accurately reflect the outcomes of SNF-based rehabilitation care in 1996 and 1997, immediately prior to the implementation of the prospective payment systems in SNFs and IRFs.

If IRF- and SNF-based rehabilitation care are equally effective in restoring function for persons with a stroke or hip fracture and returning them to the community, and reimbursement is lower in one of the settings, then increased use of lower-cost rehabilitation care could achieve cost savings for the Medicare program, while achieving the best possible recovery for patients.

Research Questions: Patients with Hip Fractures

1) Did the percentage of patients with hip fracture discharged to the community differ for IRFs versus SNF-based rehabilitation programs, after adjusting for covariates?

2) Did the functional outcomes of patients with hip fracture treated in IRFs differ from those achieved by patients treated in SNF-based rehabilitation programs, after adjusting for covariates?

3) Did Medicare payments for patients with hip fracture treated in IRFs differ from Medicare payments for SNF-based rehabilitation care across all case-mix groups?

Research Questions: Patients with Stroke

1) Did the percentage of patients with stroke discharged to the community differ in IRFs versus SNF-based rehabilitation programs, after adjusting for covariates?

2) Did the functional outcomes of patients with stroke treated in IRFs differ from those achieved by patients treated in SNF-based rehabilitation programs, after adjusting for covariates?

3) Did Medicare payments for patients with stroke treated in IRFs differ from Medicare payments for SNF-based rehabilitation care across all case-mix groups?

CHAPTER 2: REVIEW OF THE LITERATURE

This chapter begins with background information about rehabilitation services provided in IRFs and SNFs, including Medicare regulations, and then describes how these facilities responded to the acute care prospective payment system, the utilization and Medicare expenditures since the 1980s, the factors associated with utilization, and the costs of rehabilitation care.

The second section of this chapter, which focuses on patients' rehabilitation outcomes, includes a review of factors associated with recovery after a hip fracture, factors associated with recovery after stroke, and market factors related to the outcomes of care. The chapter ends with the review of 3 investigations that compared the outcomes and costs of rehabilitation care provided in IRFs and SNFs for patients with stroke and patients with hip fractures.

Medical Rehabilitation Services

Definition of Rehabilitation Services

Rehabilitation is a restorative and learning process, which seeks to hasten and maximize recovery following a major illness or injury by treating the resulting impairments, disabilities and societal limitations.[19] Medical rehabilitation programs offered in inpatient settings provide a bridge between the acute care

hospital stay, where patient medical conditions begin to stabilize, and the return home. During an inpatient rehabilitation stay, the goals of treatment are to foster an individual's ability to manage his or her own daily activities, and, as much as possible, to return the person to an active and productive life in a community-based setting.[20]

The two major providers of inpatient rehabilitation services in the U.S. are IRFs and SNFs. Medicare certification requirements and coverage for IRFs and SNFs are described below, and summarized in Table 2.1.

Inpatient Rehabilitation Facilities (IRFs): Definition, Medicare Certification Requirements and Coverage

IRFs, which include rehabilitation hospitals and rehabilitation units within short-stay (general) hospitals, provide intensive therapy (i.e., three hours of therapy at least five days a week), including physical, occupational, and speech therapy to patients with functional disabilities resulting from physical illness or injury.[21] Medicare certification rules require that at least 75 percent of the patients served by an IRF receive care for one or more of 10 specified conditions related to neurological and musculoskeletal disorders and burns.[21, 22]

Patients admitted to an IRF must have frequent physician involvement, have 24-hour rehabilitation nursing, need intensive rehabilitation services, and be cared for by a coordinated group of skilled professionals.[21]

Table 2.1 Medicare Requirements for Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) in 1996/1997[9, 21, 23]

Issue	IRFs	SNFs
Eligibility for admission	Eligibility determined by a physician	Patient must have had a hospital stay of at least 3 days in the 30-day period before the SNF admission
Maximum length of stay	90 days; 60 reserve days may be used once in a lifetime	100 days
Cost-sharing requirements in 1997	*Deductible:* $760/spell of illness *Co-insurance:* $190 daily starting on 61st day; if reserve days are used, $380 daily for days 91 through 150.	No deductible Co-insurance: $95.50 daily starting on 21st day
Medical conditions treated	75% of patients (all payers) must have at least 1 of 10 rehabilitation diagnoses (neurologic or musculoskeletal conditions, burns)	no requirements
Hospital transfer requirements	--	SNFs must have a transfer agreement with a hospital
Physician involvement	Patients must require frequent physician involvement	SNFs must have a physician who supervises care, and a physician who is available 24 hours a day on an emergency basis
Nursing care	Patients must require 24-hour rehabilitation nursing care	SNFs must have sufficient staff to provide 24-hour nursing services
Other allied health professions	Patients must require a coordinated group of skilled professionals	Dietary, pharmaceutical, dental and medical services must be available
Therapy hours required	Patients must receive at least 3 hours of therapy at least 5 days a week	--
Medicare certification requirements	IRFs may be deemed to meet Medicare certification requirements by achieving accreditation from a national body that meets or exceeds the Medicare conditions of participation (e.g., JCAHO)	--
Medicare reimbursement guidelines in 1996 & 1997	IRFs were reimbursed on a cost-related basis subject to per-discharge limits.	Routine costs paid on an actual cost basis up to a per diem limit, ancillary services paid on a reasonable basis, and capital costs paid on a pass-through basis. Ancillary services not directly provided by SNF (i.e., independent contractor) could be paid under Medicare Part B.

IRF refers to Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; JCAHO, Joint Commission on Accreditation of Healthcare Organizations.

Many patients who are admitted to IRFs are 65 years of age or older, and thus Medicare, the Federal insurance program for the elderly and disabled, is responsible for approximately 70 percent of payments made to IRFs.[24]

Medicare fee-for-service coverage for treatment in an IRF is included under the Part A hospital benefit. A physician determines whether a Medicare beneficiary is eligible to be admitted to an IRF. An IRF may be deemed to meet Medicare certification requirements if it is accredited by a national agency that has requirements that meet or exceed Medicare conditions of participation.[21]

Under the Medicare fee-for-service program, for each spell of illness (i.e., benefit period, which usually begins with an acute care stay), the beneficiary is responsible for paying a deductible ($760 in 1997). Starting on day 61, the patient is also responsible for paying a daily coinsurance rate ($190 in 1997). Medicare covers up to 90 days per spell of illness. After 90 days, the beneficiary pays all hospital costs. Each enrollee is entitled to an additional lifetime reserve of 60 days to cover extended hospitalizations; the daily co-payment for lifetime reserve days is one-half of the deductible.[22, 23]

In 1996 and 1997, Medicare payments to IRFs were made based on the rules established under the Tax Equity and Fiscal Responsibility Act of 1982. Payments for inpatient operating costs were based on the provider's Medicare-allowable inpatient costs or a facility-specific limit. Each provider's limit equaled

its target amount (its base-year costs per discharge updated to the current year) times its current volume of Medicare discharges. Providers with costs below the ceiling received compensation for their costs, plus an incentive payment, which was half the difference between costs and the limit, up to 110 percent of the ceiling. Medicare-allowable inpatients capital costs were paid in their entirety.[22]

IRFs are now paid under a Medicare prospective payment system based on the Case Mix Group (CMG) classification system.[25]

Skilled Nursing Facilities (SNFs): Definition, Medicare Certification Requirements and Coverage

Skilled nursing facility (SNF) services are provided in freestanding SNFs and hospital-based SNFs. In addition, rural hospitals designated as swing-bed facilities may use acute-care beds to provide SNF services to Medicare beneficiaries.[21] SNFs provide a variety of services including nursing care, physical, occupational, respiratory, and speech therapy, and medical social services. SNFs must have a transfer agreement with a hospital to accept patients recommended for SNF care; sufficient staff to provide 24-hour nursing services; a physician who supervises patient care and is available 24 hours a day on an emergency basis; as well as dietary, pharmaceutical, dental and medical social services available.[9, 14]

It is estimated that Medicare pays for only 10 percent of care provided by all SNFs, but that figure increases to approximately 80 percent[26] when limited to care provided in subacute programs in SNFs.

Under the Medicare fee-for-service program, eligibility for the SNF benefit is restricted to beneficiaries with a hospital stay of at least 3 days during the past 30-day period. Coverage is limited to a maximum of 100 days for each spell of illness. There is no deductible, but starting on the 21st day of a spell of illness, a daily co-insurance ($95.50 in 1997) is paid by the beneficiary.[23]

In 1997, Medicare reimbursed SNFs on three different bases: 1) Routine operating services, such as room and board, and skilled nursing services were paid on an actual cost basis up to a per-diem limit; 2) ancillary services were paid on a reasonable-cost basis; and 3) capital expenses were paid on a pass-through basis. Separate cost limits applied to hospital-based and freestanding SNFs, and rural and urban SNFs. New providers were exempt from these limits for the first three years. A SNF could receive exception payments if it could demonstrate that its case mix was sufficiently higher than the national average to warrant higher payments.[9]

In 1997, there were no cost limits for capital expenses or for ancillary services such as laboratory tests, radiology procedures, or physical, occupational, and speech therapy.[22] Ancillary services costs represented an increasing amount of

SNF payments, to become almost half by 1995[9, 27] Prior to 1998, it was not unusual for independent rehabilitation agencies and durable medical equipment suppliers to provide services to SNF patients and bill them directly to Medicare Part B.[28] Lui[29] estimated that 15 percent of therapy charges in 1990 were billed to Medicare Part B. Discontinuity between Part A and Part B accounting systems meant that Medicare could not readily monitor total program spending for SNFs.[9]

In 1998 Medicare reimbursement for SNFs was changed to a prospective payment system using the Resource Utilization Groups (RUGs) classification system.[30]

Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Respond to the Acute Care Prospective Payment System

Although most Medicare regulations for IRFs and SNFs remained unchanged until the introduction of the prospective payment systems, the distinctions between the types of patients and the care provided in IRFs and SNFs decreased following the implementation of the DRG system in 1984.

IRFs began admitting a more diverse mix of patients, including patients with non-traditional rehabilitation diagnoses, such as cancer and debility, and patients with other medically complex conditions.[4, 5] In addition, a higher proportion of patients discharged from acute care with the traditional rehabilitation diagnoses were

admitted to IRFs. For example, Berg[6] reported that the proportion of patients with hip fracture transferred from a short-stay hospital to an IRF increased from 8.7 percent in 1987 to 12.2 percent in 1991. Among persons with stroke, the percentage of patients transferred from a short-stay hospital to an IRF increased from 12.9 percent in 1987 to 16.2 percent in 1991. Koval et al.[31] reported that the percent of patients with hip fracture who were discharged from the acute care unit to an IRF increased from 9 to 64 percent after a rehabilitation unit was opened in the short-stay hospital. Koval attributed this change as part of an effort to decrease the duration of the acute care stay, and improve the functional recovery of patients with hip fracture.

Some SNFs reacted to the acute care prospective payment system and the increased needs of higher acuity patients by providing more intensive therapy services, and referred to their programs as "subacute rehabilitation."[17, 18, 32] Although not formally recognized by the Centers for Medicare and Medicaid Services (CMS), subacute care was defined by the Joint Commission for the Accreditation of Healthcare Organizations (JCAHO)[32] as:

> "...goal-oriented, comprehensive, inpatient care designed for an individual who has an acute illness, injury, or exacerbation of a disease process. It is rendered immediately after, or instead of acute hospitalization to treat one or more specific, active, complex medical conditions or to administer one or more technically

> complex treatments in the context of a person's underlying long-term conditions and overall situations...Subacute care is generally more intensive than traditional nursing facility care and less intensive than acute inpatient care. It requires frequent (daily to weekly) patient assessment and review of the clinical course and treatment plan for a limited time period (several days to several months), until a condition is stabilized or a predetermined treatment course is completed." (page 60)

Salcido[32] further defined "subacute rehabilitation" as:

> "a level of rehabilitative care designed to meet the needs of patients who medically and physically are too frail to participate in the rigors of a conventional inpatient physical rehabilitation program (i.e., 3 hours or more of daily therapy). Subacute rehabilitation also may be appropriate for patients who do not require intense multiple therapies but may have medical comorbidities and complicating factors that require the medical supervision of a physiatrist. Physicians usually visit patients in subacute rehabilitation two or three times per week, based on medical necessity...Subacute rehabilitation is comprehensive but less intense than comprehensive rehabilitation, depending on patient needs. It

focuses on issues that promote recovery of functions that may have been impaired by a patient's illness or surgery." (page 60)

Utilization and Medicare Expenditures for Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs)

Prior to the mid 1980s, care provided by IRFs and SNFs and other post acute care providers (i.e., home health care agencies and long-term care hospitals) represented only a small percentage of total Medicare expenditures; post acute care was considered as a cost-effective alternative to extended acute care hospital stays.[9] By the early 1990s, care in post acute care settings was the fastest growing area of the Medicare program.

As reported in Table 2.2, between 1985 and 1996, the number of Medicare certified IRFs in the U.S. increased from 454 to 1,048, and the number of SNFs certified by Medicare increased from 6,725 to 15,553.[9, 22, 33, 34]

Table 2.2 The Number of Medicare-Certified Inpatient Rehabilitation Facilities and Skilled Nursing Facilities: 1985, 1990, 1992, 1994, 1996.[9, 22, 33, 34]

Provider Type	1985	1990	1992	1994	1996
Inpatient Rehabilitation Facilities (total)	454	813	923	1,019	1,048
Freestanding hospital	68	135	164	195	189
Distinct-part unit	386	678	759	824	859
Skilled Nursing Facilities (total)	6,725	10,508	12,174	13,878	15,553
Hospital-based units	NA	1,145	1,352	1,718	2,084
Freestanding facilities	NA	8,120	9,502	10,818	12,086
Swing-bed facilities	NA	1,243	1,320	1,342	1,383

NA refers to not available

There was also increased utilization of IRFs and SNFs and increased Medicare payments to IRFs and SNFs. Table 2.3 shows that the number of Medicare patients discharged from IRFs increased over three-fold from 1986 to 1994, from 90,000 to 288,000, and Medicare payments to IRFs increased almost five-fold during this time period, from $800 million in 1986 to $3.9 billion in 1994.[9, 22, 33, 34]

Between 1986 and 1994, the number of Medicare beneficiaries using SNF services increased more than three-fold from 304,000 to 1,068,000, and Medicare payments to SNFs increased almost 12-fold from $500 million to $5.9 billion.[9, 22, 33, 34]

Table 2.3 Estimated Medicare Payments and Discharges for IRFs and SNFs, Fiscal Years 1986 – 1994.[10, 22]

Year	Inpatient Rehabilitation Facility		Skilled Nursing Facility	
	Payments (in billions)	Medicare Discharges (in thousands)	Payments (in billions)	Medicare people served (in thousands)
1986	$0.8	90	$0.5	304
1987	1.0	105	NA	293
1988	1.2	121	1.0	384
1989	1.4	135	2.8	636
1990	1.9	172	1.8	638
1991	2.4	207	2.3	671
1992	3.1	234	3.1	785
1993	3.7	262	4.4	908
1994*	3.9	288	5.9	1,068

* did not include Medicare + Choice patients
NA not available

In 1986 SNF payments accounted for 0.7 percent of Medicare Part A expenditures; by 1994, SNF payments accounted for 4 percent of Part A expenditures.[10, 22]

Many analysts and researchers have attributed the increased use of IRFs and SNFs and associated rising expenditures to the implementation of the DRG system.[1-3, 11] The DRG system, a fixed-price payment system, produced strong incentives to discharge patients from acute care as soon as possible, and therefore increased the number of people requiring some type of post acute care service.[2, 11, 28]

Other factors, including improvements in technology, clinical advances, Medicare policy changes and the number of persons eligible for Medicare benefits, may have also contributed to the increased use of these post acute services. For example, improvements in technology allowed more complex services to be delivered in settings that were less intense than acute care, permitting non-acute facilities to treat patients who were sicker.[12] Clinical advances in the areas of surgery, anesthesia, and rehabilitation expanded the types of medical conditions for which restorative care could be a benefit, and allowed patients to begin rehabilitation sooner after illness onset.[12]

In addition to these advances, changes in eligibility and coverage guidelines in the late 1980s increased access to SNFs.[9] There was also an increase in the number of Medicare beneficiaries during this time period. In 1985, there were 31.1 million persons enrolled in part A or part B of the Medicare program, of which 28.1 million were eligible because of age. In 1997, there were 38.4 million Medicare beneficiaries, of which 33.6 million were 65 years of age or older.[35]

Factors Associated with Utilization of Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs)

As Medicare expenditures for post-acute care settings began to increase rapidly, policy analysts and health services researchers began to ask questions about the most appropriate use of post acute care. The questions posed by Kane[11] were:

1) What factors are associated with receipt of different types of post acute care?
2) What are the costs associated with care in the different post acute care settings?
3) Do patient outcomes vary across the different post acute care settings, after adjusting for covariates?

Patient Factors Related to Use of Post Acute Care

Descriptive studies found that patients with certain medical conditions had high use of post acute care in 1995. Patients with hip and femur procedures except major joint, age over 17 years with complications or comorbidities (DRG 210), patients with cerebrovascular disorders except transient ischemic attacks (DRG 14), and patients with major joint and limb reattachment procedures of lower extremity with complications or comorbidities and age over 17 years (DRG 209) each had a high proportion of patients (85%, 83% and 63%, respectively) discharged to a SNF, IRF or home health agency.[12]

For Medicare patients with major joint and limb reattachment procedures (DRG 209), 7.2 percent were admitted to an IRF following their acute care stay, 15.2 percent were admitted to a SNF, 26 percent received home health care services, 34.6 percent used more than one post acute care service, and 27.0 percent did not receive any post acute care services.[12]

Among Medicare patients with stroke (DRG 14), 5.2 percent were admitted to an IRF, 19.5 percent were admitted to a SNF, 16.5 percent received home health care services, 21.5 percent used two or more post acute care services, and 37.0 percent did not use any of these services.[12]

Other patient factors associated with use of post acute care included the patient's functional status, whether the patient lived alone, and the patient's age.[11, 12, 14]

Market Factors Associated with Use of Post Acute Care

Studies have found that use of post acute care varies by geographic region.[6, 11-14, 36] These variations may be explained by different patient needs in a region, as well as market factors such as regional practice patterns, the supply and ownership of post acute care providers, managed care penetration in a region, and varying Medicaid program policies.[12]

Analyses of 1995 Medicare data showed that the number of SNF discharges per 1,000 beneficiaries living in a geographic region varied from 35.8 per 1,000 beneficiaries in the South Atlantic region to 61.8 per 1,000 beneficiaries in the West North Central region. Use of IRFs also varied, from 4.2 discharges per 1,000 beneficiaries in the Pacific region to 15.0 per 1,000 beneficiaries in the West South Central region.[14]

The Medicare Payment Advisory Commission found that when there is a higher concentration of facilities in a region, there is proportionally higher use of these facilities. For example, the West South Central region, which had the highest use of IRFs per 1,000 beneficiaries, had almost twice (1.8) as many IRF beds per 1,000 beneficiaries compared to the national average.[14]

Blewett and colleagues[16] reported that hospital ownership of a post acute care facility was associated with a 10 percent increased use of post acute care.

The type of post acute care used has been found to vary by a patient's type of health insurance.[15, 37] Retchin[15] found that Medicare beneficiaries with managed care coverage (i.e., patients with Medicare+Choice) who experienced a stroke were more likely to be admitted to a SNF than an IRF when compared to Medicare fee-for-services patients.

The Costs of Treatment in Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs)

Analyses of financial data have consistently shown that care in an IRF was more costly than care in a SNF.[12, 17, 18] Gage compared unadjusted Medicare program costs for the year 1995, and found that for patients who received acute care hospital and SNF services, the average total Medicare payment was $15,183, of which $5,698 was for SNF services. For patients who used acute care hospital and IRF services, the total Medicare payments were $19,992 on average, including a mean IRF payment of $8,877.[12]

Large differences remained when the 1995 data were analyzed separately by medical condition. The mean Medicare payment for patients with a stroke (DRG 14) was $11,559 for IRFs, and $6,592 for SNFs. Among patients with major joint and limb reattachment procedures (DRG 209) the mean Medicare payment was $6,616 for IRFs, and $5,098 for SNFs.[12]

Outcomes of Rehabilitation Care for Patients with Hip Fracture and Patients with Stroke

Answering the question about whether the outcomes of rehabilitation care provided in IRFs and SNFs were different was more challenging. IRFs and SNFs admitted patients with many different types of illnesses and injuries, each with

varying levels of severity. Patient outcomes were expected to differ based on the type and severity of an illness or injury, as well as characteristics of the patient, such as age.[11]

Rather than attempt to cover the entire complexity of patients, costs and outcomes of rehabilitation care, the current study narrowed its focus to 2 of the most common conditions treated in IRFs and SNFs, patients with hip fracture and patients with stroke.

The next section of this chapter reviews the literature related to the rehabilitation outcomes of patients with hip fracture and patients with stroke. It begins with background information about hip fractures and factors predictive of rehabilitation outcomes for patients with hip fractures. The discussion then shifts to background information about stroke and factors that predict rehabilitation outcomes for patients with stroke.

Hip Fracture

"Hip fracture" refers to fractures of the proximal femur. In 1996, the number of hospital admissions for hip fracture was approximately 340,000.[38]

There are two major anatomic types of proximal femoral fractures: intracapsular and extracapsular fractures.[39] Compared to patients with an intracapsular

fracture, people with an extracapsular fracture tend to be slightly older and sicker on admission to the acute care hospital, have a longer acute care stay, be more dependent with ADL skills 2 months after the fracture, and have a higher mortality rate at 2 and 6 months post fracture.[39]

Most patients with hip fractures have either a hip replacement or an open reduction with internal fixation. The surgical procedure selected for a particular individual depends on the characteristics of the patient, the type and location of the fracture, and the surgeon's experience and preference.[40]

Blacks, Hispanics and Asians have a lower incidence of hip fracture than whites. Factors associated with this lower incidence include bone mineral density, body weight, and hip axis length.[41]

Mortality rates following a hip fracture have been reported as 4.3 percent during the acute care hospital stay, 8.2 percent at 3 months, 12.6 percent at 6 months, and 17.4 percent at 12 months.[39]

Natural History of Recovery after a Hip Fracture

Following a hip fracture, most recovery in walking ability and ability to perform personal activities of daily living and instrumental activities of daily living skills occurs by 6 to 12 months.[39] Koval[42] found that by 1 year, 73 percent of patients

with hip fracture had recovered basic activities of daily living skills to the pre-fracture level, and 48 percent had recovered to their pre-fracture instrumental activities of daily living skills.

Factors that Influence Functional Recovery Following a Hip Fracture

Recovery following a hip fracture is associated with many factors, including the patient's pre-fracture functioning, social cognition status and demographic characteristics. Independence with functional skills prior to the hip fracture is significantly associated with a good short-term outcome. Most elderly persons who had good functional status prior to the hip fracture were living in a community-based setting, and thus pre-fracture residence in the community is also associated with good recovery.[43-50]

Intact cognitive function, adequate social functioning and good social support have also been shown to be significant predictors of better recovery.[39, 42–48, 51, 52]

Comorbidities, including depressive symptoms, or delirium at baseline or admission to acute care, are often associated with poor outcomes.[53-55] Goldstein reported that patients with cognitive impairment do show improvement in mobility function, but not as much as patients who exhibit no cognitive deficits. However, patients' discharge setting was not affected by cognitive function.[56, 57]

A comparison of outcomes based on the type of surgical intervention, either a hip replacement or pinning, showed that patients who had a hip replacement were more dependent in their daily living skills and walking ability when discharged from the acute care setting, but no difference was found at 6 weeks or 6 months.[58]

Female patients tend to achieve better functional recovery than men[47, 59] while patients living alone prior to the fracture status,[60] patients with poor nutrition[52] and older patients tend to have worse outcomes.[39]

Functional status at the time of admission to rehabilitation has also been found to be a significant predictor of functional recovery.[61] Among patients with hip fractures discharged in 1992, up to 54 percent of patients' discharge functional status was explained at rehabilitation admission using the function-related group case-mix classification system.[61]

Stroke

Stroke refers to the rapid onset of a neurological deficit that persists for at least 24 hours. Each year in the U.S., approximately 600,000 people have a stroke, of which about 500,000 represent a first stroke and 100,000 are recurrent strokes.[62] Ischemia is estimated to be the etiology for about 83 percent of strokes, and

hemorrhages represent approximately 17 percent of strokes.[62]

The incidence of stroke increases with age. After age 55, the incidence of stroke doubles with each decade. Stroke occurs more frequently in men than women, and blacks experience a higher incidence of stroke compared to whites.[63]

In the U.S., stroke is the third leading cause of death behind diseases of the heart and cancer. In 1999, 167,366 people died as a result of a stroke.[62]

It is estimated that 4.6 million people in the U.S. are stroke survivors with varying degrees of neurological impairments.[62]

Natural History of Recovery in Stroke Survivors

Neurological and functional recovery following a stroke, including some spontaneous recovery, occurs most rapidly in the first 3 to 6 months.[19, 64, 65] Limitations that persist 6 or more months after stroke include hemiparesis for 37 to 48 percent of persons, motor coordination problems for 61 percent of individuals, visual-perceptual deficits in 41 percent of cases, and partial or total dependence with activities of daily living in 24 to 53 percent of cases.[19, 66-69]

Factors that Influence Functional Recovery Following a Stroke

Following a stroke, functional recovery is associated with many factors, including the severity of the stroke, the timing of rehabilitation services, and patient characteristics. For example, the severity of the stroke, as evidenced by CT scan studies or functional status on admission to rehabilitation, has shown high correlations with functional outcomes.[70] Patients with hemorrhagic stroke, when they survive, may achieve better functional outcomes than patients with cerebral infarctions.[71]

Stineman,[61] in her analysis of 1992 data collected in IRFs, reported that up to 67 percent of the variance of discharge motor Functional Independence Measure (FIM™ instrument) ratings may be explained at rehabilitation admission using motor FIM scores, cognitive FIM ratings and age.

Although the type of functional deficits is related to the side of the brain lesion (left versus right brain), it makes little or no difference in the *overall* loss of motor functional status.[70]

Investigations of the time from the onset of a stroke to the subsequent rehabilitation interventions have shown that earlier rehabilitation is associated with better functional outcomes.[72-74] Longer rehabilitation stays have also been associated with increased functional improvement.[70]

With regard to patient characteristics, age at the time of stroke may be an important predictor of functional outcome, but only among individuals who are the most severely disabled.[61, 70] Among women, marital status is a predictor of the patient's ability to live independently, but the variable sex is only weakly associated with functional outcomes.[75, 76]

Blacks may have more severe residual motor impairments and more functional dependence than whites following a stroke.[63, 77] There may also be variation in the use of rehabilitation services by blacks and Hispanics as a result of the geographic distribution of the population by race[78] and variations across the country in the availability and utilization of rehabilitation services.[9, 13]

Market Characteristics That May Influence Functional Outcomes

In addition to patient factors, certain attributes of a facility or the facility's location (i.e., marketplace) may influence the effectiveness of the rehabilitation care provided. For example, the influence of managed care is an important consideration, because managed care companies have tended to favor referring patients to less expensive care settings. In a geographic location with high managed care penetration, facilities may have reorganized entire programs with the goal of increasing efficiency and effectiveness in an effort to become more competitive. Therefore, the percent of persons in a geographic location with managed care insurance may influence the outcomes of care of *all* patients

admitted to a facility rather than just managed care patients. Such changes have raised concerns about the impact on the quality of the care provided within these facilities.[79]

Another facility attribute that may affect outcomes or the cost of care is the volume of patients treated within a facility. Studies have shown that hospitals that treat a higher volume of patients with a specific condition, such as the acute care of patients with hip fractures, tend to have better patient outcomes.[80] This relationship is thought to be explained by the theory that "practice makes perfect" (i.e., treating more patients results in better outcomes) and the theory of "selective referral" (i.e., facilities with better outcomes get more referrals).[80]

Clinical Outcomes and Cost of Rehabilitation Care Provided in Inpatient Rehabilitation Facilities and Skilled Nursing Facilities

To date, 3 studies have been published that compare the functional outcomes and costs of IRF and SNF-based rehabilitation care. The sample, methodology, results and limitations of these studies are described next.

Keith et al.'s[17] retrospective cohort study compared the outcomes and charges (i.e., amount billed) for patients with stroke treated in an IRF and a SNF-based rehabilitation program during the years 1990 and 1991. The two facilities in California were part of one corporation.

Reviews of medical records showed that the 331 patients admitted to the IRF achieved significantly higher total (motor and cognitive combined) FIM rating gains than the 97 patients admitted to the SNF-based program. Patients in the IRF gained an average of 30.4 FIM units, and the patients in the SNF gained a mean of 20.6 FIM units. The discharge FIM scores, 82.5 for the IRF patients and 75.9 for the SNF patients, were not significantly different.

The percent of patients discharged to the community was not significantly different either, with 71 and 67 percent of patients discharged to community-based settings for the IRF and SNF, respectively.

Patients in the IRF had significantly longer rehabilitation stays (28.6 days for IRF versus 24.2 days for SNF), and IRF patients received significantly more therapy treatment than the patients receiving care in the SNF (114.23 total hours of treatment for IRF patients versus 50.66 for SNFs). Analysis of the financial data showed that the average daily charge was $1,021 for the IRF and $502 for SNF-based rehabilitation care.

This study suggested that rehabilitation care in an IRF was more effective when functional improvement was the outcome, but care in the two settings was equally effective when considering discharge to the community as the outcome of interest. With regard to the cost of care, the study found that the daily charges

for patients with stroke admitted to the IRF were double the daily charges of the patients admitted to SNF-based care.

Limitations of Keith's study include confounding, limited generalizability, and an early time frame. Analyses in this observation study did not take into account differences between patients admitted to the two rehabilitation settings that may have affected the outcome variables. For example, the FIM item score for Bladder Management was significantly lower for patients admitted to the IRF, a higher percentage of patients in the IRF were admitted directly from a SNF, and the race/ethnicity and payer source distributions were different for patients admitted to the two rehabilitation settings. In addition, data describing cormorbidities were not available, and thus were not considered in the analyses.

In addition, the study sample included only patients discharged in the years 1990 and 1991 from two facilities that are part of one corporation and located in one state. These findings may not be generalizable to all IRFs and SNF-based rehabilitation programs, and to more recent practices in these facilities.

In his 1996 study, Kane et al.[7] investigated the outcomes of Medicare beneficiaries discharged from 52 acute care hospitals in three metropolitan areas: Minneapolis/St. Paul, Pittsburgh and Houston. These cities were selected to represent a cross-section of the U.S., but the sample was not intended to be random. All acute general hospitals treating adults in these 3 cities were asked

to participate. In Minneapolis/St. Paul, all 19 facilities participated in the study. In Pittsburgh, 18 of the 20 facilities participated, and in Houston 15 of 31 facilities participated.

Data for Kane's study included direct patient interviews, information abstracted from the patients' medical records, data from the Medicare Automated Data Retrieval System, and hospital characteristics collected through a telephone survey and obtained from a database provided by the American Hospital Association. Comparisons were made among those patients discharged to 3 types of settings: 1) IRFs, 2) SNF-based rehabilitation programs, and 3) standard nursing homes without rehabilitation programs. The numbers of patients with stroke in each setting were 79, 30 and 93, respectively. The numbers of patients with hip fractures in the 3 settings were 89, 45 and 273, respectively.

Since this was an observational study, Kane et al. used several techniques to make comparisons of the 3 groups more equitable. In addition to adjusting statistically for important covariates, including demographic and diagnostic characteristics, the patients with stroke and hip fracture were each grouped into two severity categories (healthier and sicker) based on activity of daily living (ADL) ratings and cognitive status at admission.

Results indicated that 6 weeks after the acute care hospital discharge, both the healthier and sicker patients with stroke discharged to IRFs achieved significantly

greater functional improvement ($p < .05$) than patients treated in SNF-based programs or standard nursing homes. Healthier patients with hip fracture who received IRF services achieved the highest functional improvement compared to patients who received SNF-based rehabilitation or standard nursing home care. Among the sicker patients with hip fracture, however, functional improvement was not significantly different for patients discharged to the 3 different settings.

This study suggested that patients with stroke and healthier patients with hip fracture admitted to IRFs had greater functional improvement than comparable patients admitted to SNFs.

The sample size in this study was limited, given the need to stratify patients into 3 post acute care settings and 2 severity groups. In addition, results based on data from 3 metropolitan areas collected in 1988-1989 may not be generalizable to other areas of the U.S., and may not reflect more recent practices.

Kramer et al.[18] investigated the outcomes and reimbursement of rehabilitation care for patients with hip fracture and stroke using data from a stratified random sample of 92 IRFs, SNF-based rehabilitation programs and standard SNFs from 17 states. The sampling frame included Medicare patients who were over 65 years of age, had an acute hospital stay within the last 30 days, had no previous skilled nursing or rehabilitation admission, and were discharged between 1991 and 1994.

The Kramer study sample included 450 patients with stroke, of whom 271 (60%) were treated in an IRF, 108 (24%) received care in SNF-based rehabilitation, and 71 (16%) received care in a standard SNF. Among the 479 patients with hip fractures included in the study, 168 (35%) received care in an IRF; 190 (40%) received SNF-based rehabilitation; and 121 (25%) were treated at a standard SNF.

Patients treated in IRFs, when compared to SNF patients, tended to be younger, were more likely to have a caregiver, were only rarely admitted from a nursing home, had significantly better premorbid function, had fewer comorbidities, had fewer dependencies in ADL skills and cognition at the time of rehabilitation admission, and were more likely to participate in social or recreational activities.

Since the type of post acute rehabilitation service received by patients was not randomized, case-mix adjustment was necessary. Seven groups of patient characteristics were used for case-mix adjustment, including demographic characteristics, social support measures, premorbid functional status (number of ADL dependencies, up to 5), acute medical or surgical characteristics, including co-morbidities, condition at admission to rehabilitation, functional status at rehabilitation admission (number of ADL dependencies, up to 6, and Barthel Index scores), and cognitive and psychological status.

The primary outcome of this study was living setting, assessed at 3 and 6 months after the post acute care admission. After adjusting for covariates, the likelihood of a community-based residence among patients with stroke admitted to IRF programs was 3.3 times (95% confidence interval: 1.5 - 7.2) higher than those admitted to SNF-based rehabilitation programs and standard nursing homes combined. A comparison of patients admitted to IRFs and SNF-based rehabilitation programs showed a non-significant odds ratio of 2.0 (95% confidence interval: 0.8 – 4.8).

The records of patients with stroke were split for further analyses into 6 groups based on motor and cognitive function and available support. Within each subgroup, the patients discharged from IRFs had fewer difficulties with ADL skills than those discharged from SNFs (both SNF-based rehabilitation programs and standard SNFs combined).

The patients with hip fractures treated in IRFs were not more likely to return home when compared to patients treated in SNF-based rehabilitation programs, but treatment in a SNF-based rehabilitation program did significantly increase the likelihood of a community-based discharge compared to care received in standard nursing homes. To compare functional status after 6 months, patients were stratified into 5 groups based on motor and cognitive functional status data and the amount of available support. Overall, the difference between functional outcomes of IRF and SNF (both SNF-based rehabilitation programs and

standard SNFs combined) care was not statistically significant.

Kramer et al. reported that after adjusting for covariates, treatment in an IRF was more expensive than SNF-based rehabilitation care.

In Kramer's study, patients with stroke admitted to IRFs had better functional outcomes than patients with stroke admitted to either type of SNF (SNF-based rehabilitation programs or standard SNFs). The outcomes for patients with hip fracture were not different for IRFs and SNF-based rehabilitation programs.

In this study, the facilities were randomly selected, as were the patients within each facility. Investigators were not able to randomize patients into the treatment setting, and therefore accounted for differences between the groups by statistically adjusting the data. As with the previous two studies, the sample size was limited given the need to stratify patients into 3 treatment settings, and thus analyses by the 5 hip fracture and 6 stroke severity groups compared IRFs and all SNFs (both SNF-based rehabilitation programs and standard SNFs combined).

Together, these 3 studies[7, 17, 18] suggest that patients with stroke admitted to IRF programs achieved more functional independence than patients admitted to SNF-based rehabilitation programs. Among patients with stroke, reimbursement for IRF care is significantly higher than reimbursement in SNF-based programs.

Among the patients with hip fractures, Kramer's study found that functional outcomes for patients in IRFs and SNFs were not different across 6 severity subgroups, and Kane's study found that healthier patients achieved better functional outcomes after receiving care in an IRF than did healthier patients treated in SNFs. Medicare reimbursement for IRF care was significantly higher than reimbursement in SNF-based programs for patients with hip fractures.

These 3 studies[7, 17, 18] provide some evidence of the relative effectiveness of IRFs and SNF-based rehabilitation for persons with stroke and hip fractures. Nevertheless, important questions regarding the role of severity of disability remain unanswered.

CHAPTER 3: METHODOLOGY

This chapter describes the methods used in this retrospective cohort study to compare the outcomes and Medicare reimbursement of rehabilitation care provided in IRFs and SNFs to patients with hip fracture and patients with stroke. The methodology included linking administrative data from two sources so that clinical outcome and payment data for the same patient stay were available in one record.

This chapter begins with a description of the study sample, followed by an overview of the two organizations that provided administrative data for the study, descriptions of the administrative data, and a discussion of the procedures used to link patient records from the two sources. The chapter ends with descriptions of the variables used in the data analysis, and the statistical procedures used to answer the research questions.

Study Sample

The study sample included individuals with Medicare fee-for-service medical insurance who had a recent stroke or hip fracture and who were discharged from an IRF or a SNF-based rehabilitation program that subscribed to the Uniform Data System for Medical Rehabilitation (UDSMR) in 1996 or 1997.

Since the focus of this study was to evaluate the outcomes (i.e., end results) and reimbursement of rehabilitation care, the records of individuals who had incomplete or atypical rehabilitation stays were excluded from the analyses. More specifically, this study *excluded* the records of Medicare fee-for-service beneficiaries who:

a) were not living in the community prior to the onset of the medical condition (i.e., stroke or hip fracture);
b) were admitted to the rehabilitation program more than 60 days after the hip fracture or stroke;
c) were admitted to the rehabilitation program directly from an inpatient rehabilitation facility;
d) were discharged from the rehabilitation program to an acute care hospital;
e) died while in the rehabilitation program;
f) had a rehabilitation length of stay (LOS) that was shorter than 3 days;
g) had a rehabilitation LOS that was longer than 3 standard deviations above the mean log of the rehabilitation LOS for the medical condition (stroke or hip fracture); or
h) had a program interruption during the rehabilitation stay.

In addition to excluding the records of patients who had atypical stays (listed above), records were also excluded from the analyses if either the admission or discharge Functional Independence Measure (FIM^{TM} instrument) data were missing.

Table 3.1 describes the rationale for considering cases with each of the listed criteria as incomplete or atypical stays.

Table 3.1 Study Exclusion Criteria and Rationale

Exclusion Criteria		Rationale for considering these stays as "incomplete" or "atypical"
1	Patients who were not living in the community prior to the onset of the condition	Patients who are not living in the community prior to the event are less likely to be discharged to a community-based setting.
2	Patients who had an onset to rehabilitation admission time of longer than 60 days	Patients who have an onset time of more than 60 days may 1) be expected to have a different recovery trajectory because of the delay in starting rehabilitation care, and 2) have other medical conditions that could interfere with the rehabilitation process.
3	Patients who were admitted to the rehabilitation program from another rehabilitation facility, skilled nursing facility or a long-term care hospital.	These patients began the rehabilitation process in another setting. Therefore, the current rehabilitation stay is incomplete.
4	Patients who were discharged from the rehabilitation program to an acute care facility	The rehabilitation stay was stopped prematurely because of a medical condition requiring immediate or more intensive medical attention.
5	Patients who died while in the rehabilitation program	The rehabilitation stay was stopped prematurely because of death.
6	Patients who had a length of stay that was 3 days or fewer	The rehabilitation treatments were not likely completed within 3 days.
7	Patients who had a rehabilitation stay that was longer than 3 standard deviations above the mean log rehabilitation stay for each condition	Patients with extremely long stays in rehabilitation may have complications or comorbidities that are interfering with the recovery process
8	Patients who had a program interruption during the rehabilitation stay	Patients with interrupted stays have 1 or more serious medical issues during the rehabilitation program, requiring that the patient return to an acute care setting for a period of 30 days or less before resuming the rehabilitation program.

Primary Data Sources

The two primary sources of data for this study were: 1) the Centers for Medicare and Medicaid Services (CMS), and 2) the Uniform Data System for Medical Rehabilitation (UDSMR).

The investigator signed confidentiality agreements with UDSMR and CMS prior to obtaining data from the 2 organizations. The study plan was then reviewed and approved by the University at Buffalo's Health Sciences Institutional Review Board.

The next section of this chapter describes the two organizations that provided the study data, and the administrative data that were furnished.

Overview of Centers for Medicare and Medicaid Services (CMS) and CMS Data

The Centers for Medicare and Medicaid Services (CMS), a division of the United States Department of Health and Human Services, oversees the Medicare program. Medicare is the Federal Government's health insurance program for people 65 years of age and older, some disabled people under 65 years of age, and people with end-stage renal disease. In 1997, the Medicare program insured over 38 million people.[35]

Data available from CMS included reimbursement claims and records of services paid for by CMS for beneficiaries in the traditional fee-for-service plan. Data for beneficiaries participating in private-sector health plans (i.e., the Medicare+Choice program) were not available, or were incomplete.

The traditional fee-for-service Medicare program has 2 parts: 1) Part A, which is the Hospital Insurance, helps cover the costs of institutional care such as hospital (including an inpatient rehabilitation facility), skilled nursing facility, home health and hospice care; and 2) Part B, which covers the costs of physician, outpatient, ambulance and clinical/laboratory services and miscellaneous supplies.

Two types of Medicare data files for the years 1996 and 1997 were used in this study: 1) The Medicare Provider Analysis and Review (MedPAR) data files, which included stay-level data derived from claim data from all inpatient hospital and SNF stays paid for by the traditional fee-for-service Medicare program; and 2) the Medicare Denominator files, which indicated whether beneficiaries were enrolled in the traditional fee-for-service program, both Medicare Part A and Part B, on a monthly basis.

CMS Data Request

CMS staff were asked to search all 10 diagnosis code variables within the 1996 and 1997 MedPAR hospital (long stay and short stay) and SNF files for records

that had the following International Classification of Diseases 9th Revision, Clinical Modification (ICD-9-CM) diagnostic codes:

Stroke:

- 342.9: Hemiplegia, unspecified
- 430: Subarachnoid hemorrhage, including ruptured berry aneurysm
- 431: Intracerebral hemorrhage
- 432.0 to 432.9: Intracranial hemorrhage
- 433.00 to 433.91: Occlusion or stenosis of precerebral arteries
- 434.00 to 434.91: Occlusion of cerebral arteries
- 436: Acute, but ill defined, cerebrovascular disease
- 437.0 to 437.9: Cerebrovascular disease, ill-defined and other
- 438: Late effects of cerebrovascular disease

Hip Fracture:

- 820.00 to 820.9: Fracture of neck of femur

The CMS data were provided to the investigator on 3480 International Business Machine standard label cartridges. These data were read using the REELlibrarian program on the University at Buffalo's UNIX, and then downloaded onto compact disks for analysis on a personal computer.

Within these files, subsets of patient records from rehabilitation facilities were identified, and a “health insurance claim finder” file was created and sent to CMS, so that CMS staff could send additional data associated with these stays.

Using the submitted health insurance claim finder file, CMS performed cross-reference searches against the 1996 and 1997 Denominator data files.

The hospital and SNF MedPAR data files included 1 record for each hospital or SNF stay that was reimbursed by Medicare for patients covered by the traditional fee-for-service program. A “stay” record summarized all services rendered to a beneficiary from the time of admission to a facility through discharge. Each MedPAR record may have represented one claim or multiple claims, depending on the beneficiary’s stay and the amount of inpatient services used throughout the stay. Each patient record included demographic data, such as age, sex, race, and residential Zone Improvement Planning (ZIP) code; and diagnostic and hospitalization data, including diagnosis codes, procedure codes, admission date, discharge date, deductibles, co-insurance payments, Medicare reimbursement, primary payer reimbursement and charges by department.

The MedPAR hospital files for the years 1996 and 1997 included all records in which the Medicare patients were *discharged* in 1996 and 1997, respectively. The 1996 and 1997 SNF files, however, included all records in which the Medicare patients were *admitted* in 1996 and 1997, respectively.

The 1996 MedPAR SNF records included 466,283 patient stay records, and the 1996 MedPAR Short and Long Stay Hospital file contained 1,560,941 patient stay records. For 1997, MedPAR SNF records included 460,741 patient stay records, and the 1997 MedPAR Short and Long Stay Hospital file contained 1,460,199 patient stay records.

Overview of the Uniform Data System for Medical Rehabilitation (UDSMR) and UDSMR Data

The Uniform Data System for Medical Rehabilitation (UDSMR) is a data repository and reporting system for rehabilitation programs. UDSMR is affiliated with the University at Buffalo, State University of New York, School of Medicine and Biomedical Sciences, in the Department of Rehabilitation Medicine. It is operated as a division of the UB Foundation Activities, Inc., a non-profit entity.[81]

Staff from facilities that subscribe to UDSMR submit patient records to UDSMR on a quarterly basis in order to receive performance feedback reports that describe the characteristics and clinical outcomes of patients discharged from their rehabilitation programs. Feedback reports also include comparison regional and national statistics that have been used for benchmarking.[82] Facility administrators subscribed to UDSMR on a voluntary basis, and paid a yearly fee for the service. Facility administrators have used the data from the performance

reports for internal quality management efforts, in newsletters and marketing materials, and to help meet accreditation requirements.

The UDSMR has been collecting and reporting data for IRFs since 1988, and for SNFs providing rehabilitation services since 1992. In 1996, 608 IRFs submitted data to the UDSMR,[83] approximately 58% of the 1,048 rehabilitation hospitals and units that were certified by Medicare.[35] In 1996, 189 SNFs submitted data to UDSMR.[84] In 1996, 15,553 SNFs participated in the Medicare program,[35] but the number of SNFs that offered subacute rehabilitation services is not clear. The 1995 Trends in Special Care Survey found that approximately 1,712 nursing homes had rehabilitation units.[85] A survey conducted by the Medical Expenditure Panel Survey estimated that 4.9 percent, or approximately 825 nursing homes, provided subacute or rehabilitation services in 1996.[86] Thus, 189 facilities would represent approximately 11 or 25 percent of SNFs that provide subacute rehabilitation services, depending on the survey used as the reference.

UDSMR Data Request

Six data files were requested from UDSMR. Two data files contained facility data and 4 files contained patient records. The files with facility-level data were:

- 1996 facility data (SNF and IRF data combined)
- 1997 facility data (SNF and IRF data combined)

The files with patient records were:

- 1996 UDSMR IRF database
- 1997 UDSMR IRF database
- 1996 UDSMR SNF database
- 1997 UDSMR SNF database

Records for all patients, not just the records of patients with the impairment group codes of hip fracture and stroke, were requested because this variable was sometimes coded incorrectly for patients with stroke and hip fracture. For example, if a patient had a hemorrhagic stroke, the patient's primary impairment was sometimes recorded in error as non-traumatic brain dysfunction instead of a stroke when the patient was treated in a brain injury unit. Also, in some facilities, if a patient had a hip replacement due to a hip fracture, the patient's primary impairment group was sometimes recorded as hip replacement by mistake, instead of hip fracture.

Each UDSMR patient record included demographic, hospitalization and functional status data. The demographic data in each patient record included date of birth, sex, marital status, race/ethnicity, and residential ZIP code. Hospitalization and diagnostic data in each record included the admission date, discharge date, overnight leaves (i.e., program interruptions), payer source, event onset date, the rehabilitation impairment, and ICD-9-CM codes for the etiologic diagnosis, complications and comorbidities.[82] Functional status data in each record

included admission and discharge FIM ratings[82] for 13 motor skills in the areas of self-care, sphincter control, transfers and locomotion; and 5 communication and social cognition skills. A copy of the UDSMR Coding Form is included in Appendix B.

Each of the 18 FIM items is rated on a 7-level rating scale that includes 2 independent levels and 5 dependent levels. A higher rating indicates the person is more independent. Once each of the 18 items has been rated, scores may be summed to create a *Motor FIM rating* (the sum of the first 13 items) and a *Cognitive FIM rating* (the sum of the last 5 items).[82]

Investigations of the psychometric properties of the FIM instrument have found the instrument to be reliable, valid and responsive. Interrater reliability, as estimated by the intraclass correlation coefficient, was reported to be between .96 and .99 for the motor FIM score and between .91 and .97 for the cognitive FIM scores.[87]

Stineman and colleagues[88] reported that factor analyses supported the motor and cognitive dimensions of the FIM instrument. Further, reliability coefficients for each impairment category for the motor and cognitive ratings ranged from .86 to .97. Ottenbacher and colleagues[89] did a meta-analysis of 11 reliability studies, and found a median interrater reliability for the total FIM of .95 and median test-retest and equivalence reliability values of .95 and .92, respectively. For the

individual FIM items, median reliability values varied from .90 for Toilet Transfer to .61 for Comprehension. A more recent study by Harvard University and the RAND Corporation[90] that included 50 IRFs found that simple Kappa statistics for the FIM motor items ranged from .18 to .56 and for the FIM cognitive items ranged from .30 to .49. Weighted Kappa statistics ranged from .31 to .68 for the motor items, and .55 to .74 for the cognitive items.

Face validity of the FIM instrument has been evaluated and the instrument was rated as better than average by a group of rehabilitation clinicians.[91] In the assessment of concurrent validity, a strong relationship was found between FIM scores and scores on the Barthel Index[92, 93] a functional assessment tool that was commonly used in rehabilitation prior to the development of the FIM instrument. The predictive validity of FIM scores have also been shown using various dependent variables such as minutes of assistance needed by the person who is disabled,[92, 94-97] length of rehabilitation stay,[98, 99] and likelihood of a community-based discharge.[100]

The cross-sectional studies[94-97] that correlated FIM ratings with the minutes of assistance required by a person who was disabled from a helper reported that differences of 3 to 5 FIM units were associated with approximately 30 minutes of help per day.

As part of their data quality monitoring program, UDSMR requires that clinicians (e.g., nurses, therapists) who will be administering the FIM instrument take a written examination to demonstrate that they know how to rate patients. Clinicians must pass the examination with a score of 80% of higher in order to administer the FIM instrument.[81]

Variables in the UDSMR facility data file included the following facility information: facility name, ZIP code, state, Medicare Provider Number, Joint Commission on Accreditation of Healthcare Organizations (JCAHO) status (accredited or not accredited), Commission on Accreditation of Rehabilitation Facilities (CARF) status (accredited or not accredited), and type of facility (i.e., freestanding facility or unit).

The UDSMR databases for the years 1996 and 1997 included all records in which the patients were *discharged* in 1996 and 1997, respectively.

The 1996 data provided by UDSMR included 32,048 patient records from 189 SNF-based rehabilitation facilities, and 267,591 patient records from 608 IRFs. The 1997 UDSMR data included 58,519 patient records from 277 SNFs, and 294,907 patient records from 655 IRFs.

Other Data Sources

Area Resource File Data

The Area Resource File (ARF) is a database containing health and economic data for each of the nation's counties. Data in the file included: hospital utilization levels, managed care penetration rates and Medicare beneficiaries, population characteristics and economic data. These data have been frequently used in health services research studies.[101] Quality Resource Systems, Inc. maintains the ARF under contract to the Office of Research and Planning, Bureau of Health Professions, within the Health Resources and Services Administration. Funding for the ARF is provided by to the Office of Research and Planning, Bureau of Health Professions and 5 other agencies within the Department of Health and Human Services.[101]

MapInfo

MapInfo (version 4.1) is a database containing demographic and economic data by ZIP code. This study used median income data for each ZIP code. Data in the MapInfo program are supplied by Claritas Inc.[102]

Record Linkage

Introduction

As described above, the UDSMR patient records included clinical data, and the CMS records provided reimbursement (i.e., claim) data. This study required that the UDSMR patient records and CMS patient records be linked so that the clinical and reimbursement data for each patient were available in the same record for data analysis.

The UDSMR and MedPAR data did not contain a common identifier such as a Medicare Identification Number that would allow the records to be linked easily. Instead, the process of linking records was accomplished using several variables and algorithms based on statistical probabilities. This process of record linkage was used by Carter et al.[103] to link MedPAR and UDSMR data from IRFs for CMS-sponsored research.

The next section of this chapter includes a brief overview of record linkage theory, followed by a review of the steps used to link the UDSMR and MedPAR data.

Record Linkage: Background and Terminology

The objective of record linkage is to determine whether two (or more) data records refer to the same person, object or event.[104-106] The process of record linkage involves comparing each patient record in one source (e.g., MedPAR data) with patient records from another source (e.g., UDSMR data). One or more variables in the first data file must have equivalent variables in the second file. For each pair of records that are compared, the agreement status of each variable is considered, and the likelihood that the two records represent the same person, object or event is calculated, and is used to decide whether or not the records should be linked.[105]

Some terms used in record linkage theory may be used interchangeably in other circumstances, but have distinct meanings in linkage theory. These terms are defined below, and in the Glossary of Terms (Appendix A).

In linkage theory, the term *match* refers to whether records from the 2 data sources (i.e., separate data files) correspond to the same person, object or event, without regard for decisions made by the investigator. In contrast, the word *link* refers to the analytic decision made by the investigator about whether a pair of records refer to the same case, rather than the true match status. *Linkage variables* refer to the variables from the 2 data sources that are equivalent, and whose data are compared. The word *agree* indicates the codes recorded for the

corresponding linkage variables are the same in the records from the 2 sources, without regard to the match status of the records.[104]

A detailed description of linkage theory is provided in Appendix C.

Linking UDSMR and MedPAR Patient Records

This study used staged probabilistic linkage methodology[105] to identify MedPAR and UDSMR records that likely represented the same patient's rehabilitation stay. Facilities that contributed data to both sources (UDSMR and CMS/MedPAR) were identified, and records within each facility were linked if the patient hospitalization data and patient characteristics were the same or similar.

Preparation of the data for the linkage process involved 2 steps. First, patient records from the CMS and UDSMR files were selected based on the inclusion criteria, and second, data variables in the UDSMR and MedPAR files were screened and recoded, if necessary, so that the formats of corresponding linkage variables in the 2 files were the same. These 2 steps are described in more detail below.

Selection of Patient Records from MedPAR Files

The MedPAR patient records selected for the linking process were based on 3 criteria: 1) facility type, 2) ICD-9-CM diagnosis codes, and 3) admitted and discharged in the same year, either 1996 or 1997.

First, in the MedPAR *hospital* file, data were restricted to records in which the patient received care in an inpatient rehabilitation unit (Medicare Provider Number unit code = "T") or a rehabilitation hospital (3rd and 4th digits of Medicare provider number between 30 and 32). In the MedPAR *SNF* file, no facility restrictions were necessary because Medicare does not recognize or have specially-designated identification codes for "subacute" or "SNF-based rehabilitation facilities.

Second, patient records were selected in which hip fracture or stroke was an admitting diagnosis, principal diagnosis or the first or second listed medical diagnosis. Records in which hemiplegia (342.9) was listed, but not a stroke code, were not included.

The ICD-9-CM codes used to identify patients with stroke in the MedPAR files were:

- 430: Subarachnoid hemorrhage, including ruptured berry aneurysm
- 431: Intracerebral hemorrhage

- 432.0 to 432.9: Intracranial hemorrhage
- 433.00 to 433.91: Occlusion or stenosis of precerebral arteries
- 434.00 to 434.91: Occlusion of cerebral arteries
- 436: Acute, but ill defined, cerebrovascular disease
- 437.0 to 437.9: Cerebrovascular disease, ill-defined and other
- 438: Late effects of cerebrovascular disease

The ICD-9-CM codes used to identify patients with hip fracture were:

- 820.00 to 820.9: Fracture of neck of femur

Third, patient records were selected if the patient was admitted and discharged in the same year, either 1996 or 1997. This was done so that the IRF and SNF data covered the same time periods in 1996 and 1997. As noted in the description of the MedPAR data, the SNF MedPAR file included the records of patients based on the admission date (i.e., records with an admission in 1996 were included in the 1996 file), while Hospital MedPAR data and UDSMR included the records of patients based on the discharge date (i.e., records with a discharge in 1996 were included in the 1996 file).

Selection of Patient Records from UDSMR Files

The UDSMR patient records were selected based on 4 criteria: 1) primary payer source, 2) impairment group, 3) etiologic diagnosis, 4) admitted and discharged in the same year, either 1996 or 1997.

First, only patient records in which the primary payer was identified as Medicare fee-for-service (code 02) were selected. Next, records were selected in which the patient's primary impairment was stroke or hip fracture or the etiologic diagnosis listed was one of the stroke or hip fracture ICD-9-CM codes.

The Impairment Group Codes used to identify patients with stroke were:

- 1.0: Stroke,
- 1.1: Stroke, left body involvement,
- 1.2: Stroke, right body involvement,
- 1.3: Stroke, bilateral involvement,
- 1.4 Stroke, no paresis, and
- 1.9 Stroke, other.

The etiologic diagnosis ICD-9-CM codes used to identify patients with stroke were:

- 430: Subarachnoid hemorrhage, including ruptured berry aneurysm
- 431: Intracerebral hemorrhage

- 432.0 to 432.9: Intracranial hemorrhage
- 433.00 to 433.91: Occlusion or stenosis of precerebral arteries
- 434.00 to 434.91: Occlusion of cerebral arteries
- 436: Acute, but ill defined cerebrovascular disease
- 437.0 to 437.9: Cerebrovascular disease, ill-defined and other
- 438: Late effects of cerebrovascular disease

The Impairment Group Code used to identify patients with hip fracture was:

- 8.1: Status post hip fracture

The etiologic diagnosis ICD-9-CM codes used to identify persons with hip fracture were:

- 820.00 to 820.9: Fracture of neck of femur

Fourth, patient records were selected if the patient was admitted and discharged in the same year, either 1996 or 1997. As described above, this was done so that the IRF and SNF data covered the same time periods in 1996 and 1997.

Merging Records Using Linkage Variables

The process of linking the patient records from the 2 primary data sources began by identifying the facility in the UDSMR files that corresponded to the facility in the MedPAR files. Once facilities were identified, records from the same facility were

linked based on data for the following linkage variables: 1) admission date, 2) discharge date, 3) residential ZIP code, 4) age, 5) sex and 6) race.

In most cases, the data for 5 or 6 of the linkage variables agreed, and the records were linked. When fewer than 5 of the variables agreed, an objective decision about whether the 2 records should be linked was made by calculating the likelihood that the 2 records represented the same rehabilitation stay. The steps involved in linking records are reviewed next.

Step 1 – Identify Facilities from the Two Data Sources

The MedPAR and UDSMR data files use different codes to identify facilities. The MedPAR data files identify facilities using the 6-character Medicare Provider Identification number. The UDSMR data use a 3-character identifier that is assigned by UDSMR. The UDSMR facility database contains the Medicare Provider Identification number for some, but not all, hospitals and SNFs.

For UDSMR data in which the Medicare Provider Identification Number was not available, was incorrect (e.g., the Medicare Provider Identification Number did not match any MedPAR data records) or was invalid (e.g., the number identified the facility as a home health agency or long-term hospital), a variety of methods was used to identify the correct Medicare Provider Identification Number. First, the facility ZIP code distribution from UDSMR data was compared to unmatched

facility data from the MedPAR files. The CMS web site was also accessed to identify the facility's code based on the facility name and address. The Medicare Provider Identification Number provided on the CMS website represented the facility's current Medicare Provider Identification Number, and may not have been the Medicare Provider Identification Number in 1996 or 1997. For 2 facilities, Medicare Provider Identification Number changed during the year 1996.

Step 2 – Standardize the Format of Linkage Variables

The formats of the data for the 6 linkage variables in both the UDSMR and MedPAR files were standardized (i.e., same type of format and character length) in preparation for the linkage procedure. This included changing all date variables to a YYDDD format and changing the race/ethnicity data into a dichotomous variable of white or non-white.

Step 3 – Merge UDSMR and MedPAR Data

Once the linkage variables were standardized, the UDSMR data file was merged with the MedPAR data in the Statistical Program for the Social Sciences (SPSS) Version 10.0 software using the following sequence of variables:

1) Medicare provider identification number (6-digit number);
2) admit date (YYDDD);
3) discharge date (YYDDD);

4) ZIP code (5 characters);

5) age in years (up to 3 characters);

6) sex (dichotomous);

7) race/ethnicity (dichotomous).

The resulting combined MedPAR/ UDSMR database contained 3 types of records: 1) records in which the 6 variables agreed, and the MedPAR and UDSMR data were combined into 1 record; 2) MedPAR records that had not matched with a UDSMR record; and 3) UDSMR records that had not matched with a MedPAR data record.

Step 4 – Identify Record Pairs for which Five of the Six Variables Agree

The merge process sorted the patient records based on the sequence of the linkage variables (i.e., Medicare provider identification number, admit date, discharge date, ZIP code, age in years, sex, race/ethnicity). This resulted in UDSMR and MedPAR records which had the same Medicare provider identification number, the same admission and discharge dates, but for which the ZIP codes were different to be in the rows immediately above or below each other.

The combined file was reviewed to identify pairs of UDSMR and MedPAR records in which 5 of the 6 linking variables agreed (e.g., only the ZIP code or race

disagreed). These record pairs were linked, and the variable for which the data did not agree was recorded for the record pair as an error (i.e., either the UDSMR record or the MedPAR record contained an error).

For the 3 linkage variables that could derive continuous data (age, admission date, and discharge date), if the data did not agree, the absolute value of the difference between the data values in the 2 files was calculated and recorded. For example, if one file reported the patient's age as 90, and the second file indicated the patient's age was 85, the difference between the 2 files was 5 years. For the 3 other linkage variables (sex, race, and ZIP code), data from the two data sources were compared, and either the data agreed or the data did not agree.

After this first review of the merged database, the records were sorted by 1) discharge date, 2) admit date, 3) age, 4) sex, 5) race and 6) ZIP code. Sorting the data using this sequence allowed the MedPAR and UDSMR records in which discharge and other data agreed, but the admission dates did not agree, to be placed in the rows immediately above or below each other. The files were then reviewed. If admission date did not agree, but the Medicare Provider number and the remaining 5 linkage variables did agree, and the UDSMR and MedPAR records were linked, the admission date was recorded as an error.

Figure 3.1 shows a diagram of the process of merging the data files.

Figure 3.1 Process of Merging Data Files

MedPAR data file							
F	M	V1	V2	V3	V4	V5	V6
9	xx	xx	xx	xx	xx	xx	xx
9	xx	xx	xx	xx	xx	xx	xx
9	xx	xx	xx	xx	xx	xx	xx
9	xx	xx	xx	xx	xx	xx	xx
9	xx	xx	xx	xx	xx	xx	xx

UDSMR data file							
F	U	V1	V2	V3	V4	V5	V6
9	xx	xx	xx	xx	xx	xx	xx
9	xx	xx	xx	xx	xx	xx	xx
9	xx	xx	xx	xx	xx	xx	xx
9	xx	xx	xx	xx	xx	xx	xx
9	xx	xx	xx	xx	xx	xx	xx

↓ ↓

	Combined MedPAR/ UDSMR file								
	F	M	V2	V2	V3	V4	V5	V6	U
records linked →	9	xx	xx	xx	xx	xx	xx	xx	xx
records linked →	9	xx	xx	xx	xx	xx	xx	xx	xx
records linked →	9	xx	xx	xx	xx	xx	xx	xx	xx
Unlinked UDSMR →	9	xx	xx	xx	xx	xx	xx	xx	
Unlinked UDSMR →	9	xx	xx	xx	xx	xx	xx	xx	
Unlinked MedPAR →	9		xx	xx	xx	xx	xx	xx	xx
Unlinked MedPAR →	9		xx	xx	xx	xx	xx	xx	xx

The MedPAR data files included facility identification number (F), a Medicare-assigned patient identification number (M), and data for each of the 6 linkage variables (V1 through V6). The UDSMR data files includes a facility identification number (F), a UDSMR-assigned patient identification number (U), and data for each of the 6 linkage variables.

When the MedPAR and UDSMR records are merged, the resulting combined file contained records that are linked (first 3 records), unlinked UDSMR records (4th and 5th records) and unlinked MedPAR records (6th and 7th record). Within the combined MedPAR and UDSMR data file, MedPAR data were identified by the health insurance claim number and the UDSMR data were identified by a UDSMR-assigned-identifier called "counter."

Step 5 – Calculate Error Rate

The next step of the linking process involved identifying MedPAR and UDSMR records that may have been matches, but for which the data of 2 or more of the 6 linkage variables did not agree. In order to make an objective decision about whether these record pairs should be linked, the error rate and expected

agreement by chance (i.e., random agreement) for each variable were calculated.

The "error" rate (i.e., probability that the data for a variable disagree, given that the records were matched) was estimated based on the first and second review of the merged data file. For the variables sex, race and ZIP code, the number and proportion of errors for each variable was calculated. For the remaining 3 variables, if the data did not agree, the difference between the values in the 2 data files was calculated and changed into an absolute value. For each of these variables, the number and proportion of errors was then calculated for each value between 1 and 35 years for the age variable, and 1 and 35 days for the admission and discharge date variables. Most errors were between 1 and 35 years or days.

The error rates for the 6 variables were used to represented the probability that the data in the 2 records would disagree, given that the records described the same patient stay (i.e., the records were a match).

Step 6 – Calculate the Probability of Chance Agreement

To calculate the probability that the data in the 2 records agreed by chance only (i.e., the data agree, but the record pairs were not a match), the following steps were used:

1) Data from a minimum of 10 facilities were selected randomly, and UDSMR and MedPAR records within each of the 10 facilities were randomly linked.
2) The number and proportion of records in which data did agree for each variable that had a dichotomous outcome of agree or disagree was calculated.
3) For the remaining 3 variables, if the data did not agree, the difference between the values in the 2 data files was calculated and changed into the absolute value. For each variable, the number and proportion of disagreements was then calculated for each value between 1 and 35 units.

These proportions were used to represent the probability that the data in 2 records would agree by chance (i.e., the data for a variable from the 2 data sources agreed, but the records did *not* describe the same patient stay).

Step 7 – Calculate Marginal Contributions for Each Variable

For each linkage variable, weighted scores, called marginal contributions, were calculated based on the error rate and the probability of chance agreement.

For data that did agree, the error rate and probability of chance agreement data were combined by calculating the following ratio:

$$\frac{\Pr(match \mid agree)}{\Pr(not\ a\ match \mid agree)} = \frac{(1 - error\ rate)}{(1 - agreement\ by\ chance)}$$

If the data did not agree, the ratio was calculated as:

$$\frac{\Pr(match \mid disagree)}{\Pr(not\ a\ match \mid disagree)}$$

The agreement and disagreement ratios were then transformed by calculating the logarithm to the base 10 of the ratio. The resulting value, which represented the probability that the pair of records were the same patient stay, was used as the marginal contribution for that variable to the composite weight.

The error rates and chance agreement rates for each variable are reported in Appendix D. Data are reported separately for each year, medical condition and setting (i.e., IRF or SNF).

Step 8 – Review Data for Record Pairs in Which Two or More Variables Do Not Agree

Once the marginal contribution for each variable was calculated, the merged data files were reviewed for a third time to identify records in which data for 2 or more variables did not agree, and could be considered for linkage.

For records that were identified as possible matches, a composite score was calculated by summing together the marginal contributions for each linkage variable (i.e., based on whether data for each variable agreed or did not agree). If data for the continuous variables did not agree, the marginal contribution

associated with the amount of disagreement (up to 35 units of difference) was used.

A value of 2.4 or higher was selected to identify probable matches for this study. If the composite score was equal to or greater than 2.4, the records were linked. If the composite score was less than 2.4, the records were not linked.

Percent of Records Linked for the Four Databases

Table 3.2 reports the percent of MedPAR and UDSMR records that were linked for IRFs and SNFs for the 2 hip fracture databases. Overall, the median percent of records linked per facility ranged from 81.8 (for IRFs in 1997 hip fracture database) to 85.7 (for the SNFs in the 1996 hip fracture database).

Table 3.2 Percent of MedPAR and UDSMR records linked by Rehabilitation Setting and Year, 1996 and 1997 Hip Fracture Databases

Variable	1996 Hip Fracture Database		1997 Hip Fracture Database	
	IRF	SNF	IRF	SNF
Number of facilities	466	146	489	199
Median percent of records linked per facility	84.3	85.7	81.8	84.2
25th and 75th percentiles of percent of records per facility	58.7 to 96.8	60.5 to 100	55.8 to 93.5	63.5 to 98.3
Minimum and maximum percent of records linked per facility	1.0 to 100	13.0 to 100	2.0 to 100	13.0 to 100

MedPAR refers to Medicare Payment and Review, UDSMR, Uniform Data System for Medical Rehabilitation; IRF, Inpatient Rehabilitation Facility; Skilled Nursing Facility, SNF.

A few facilities submitted data to UDSMR for only a portion of the year, but would have submitted claims to Medicare for the entire year, thus a lower percentage of

records would have been linked for these facilities. The percent of records linked per facility ranged from 1.0 percent to 100 percent.

Table 3.3 provides a summary of the percent of MedPAR and UDSMR records that were linked for IRFs and SNFs for the 2 stroke databases. The median percent of records linked per facility ranged from 71.3 (for IRFs in 1997 stroke database) to 83.3 (for the SNFs in the 1996 stroke database). The percent of records linked per facility ranged from 1.0 percent to 100 percent.

Table 3.3 Percent of MedPAR and UDSMR records linked by Rehabilitation Setting and Year, 1996 and 1997 Stroke Databases

Variable	1996 Stroke Database		1997 Stroke Database	
	IRF	SNF	IRF	SNF
Number of facilities	571	147	604	208
Median percent of records linked per facility	80.8	83.3	71.3	81.7
25th and 75th percentiles of percent of records per facility	52.8 to 90.9	64.3 to 100	42.9 to 87.3	63.5 to 100
Minimum and maximum percent of records linked per facility	3.0 to 100	2.0 to 100	1.0 to 100	3.0 to 100

MedPAR refers to Medicare Payment and Review, UDSMR, Uniform Data System for Medical Rehabilitation; IRF, Inpatient Rehabilitation Facility; Skilled Nursing Facility, SNF.

A review of MedPAR records that were not linked with UDSMR records showed that these records did not include the stroke ICD-9-CM codes selected. Many of these records included the 342.xx codes indicating the patient had hemiplegia, but did not include a code indicating a stroke or the late effects of a stroke. According to the ICD-9-CM coding manual, the hemiplegia codes of 342.xx are to be used:

> “when hemiplegia (complete) (incomplete) is reported without further specification, or is stated to be old or long-standing but of unspecified cause. This category is also for use in multiple coding to identify these types of hemiplegia resulting from any cause.”[107] (page 268)

Data Cleaning

Once data records were linked, they were screened for critical data that were either invalid or missing. Missing demographic data were not a major concern. If data were missing from the MedPAR part of the patient record, then demographic data reported in the UDSMR part of the record were used. Patient records were not used in the analysis if admission FIM scores or discharge FIM scores were missing.

Variable Definitions

Dependent Variables

The purpose of rehabilitation care is to maximize an individual’s functional status and to prevent institutionalization. Thus, the effectiveness of rehabilitation programs has been measured as improvement in functional status or discharge to a community-based residence following discharge.

The primary dependent variable documenting the effectiveness of rehabilitation programs in this study was the percent of patients discharged to community-based settings. A community setting included home (i.e., house or apartment), board and care, transitional living or assisted living settings. The discharge destination reported in the UDSMR data file was used in the analyses. If the discharge destination was unspecified in the UDSMR data, then the discharge destination reported in the MedPAR data were used.

The second dependent variable in this study was motor functional status, reported as the motor FIM score at the time of discharge from the IRF or SNF-based rehabilitation program.

To answer the third research question, Medicare Part A payment data from the MedPAR data files were used. Both the actual Medicare Part A payment and a standardized version of the Medicare Part A payment are reported. The standardized payment variable represented what the payment would have been if the wage index was 1.000, and without any adjustments for indirect medical education, a disproportionate share of low-income patients, or rural location. The financial data represent the payer (i.e., Medicare) perspective and do not represent the costs of providing care.[24]

Independent Variable

The independent variable in this study was the rehabilitation setting in which a patient received treatment, either 1) an IRF or 2) a SNF-based rehabilitation program.

The type of rehabilitation setting was identified using the 6-digit Medicare provider identification number. The Medicare provider number of rehabilitation units included the letter "T" in the third digit. Rehabilitation hospitals had codes ranging from "30" to "32" in the third and fourth digit of the Medicare provider number. The Medicare provider identification number for SNFs included either a "5" or "6" as the third digit.[21]

A summary of the variable units, variable type and data source for the dependent and independent variables is provided in Table 3.4.

Covariates

As described in the review of the literature, many factors other than the rehabilitation treatments provided to patients may influence a patient's discharge destination and discharge functional status rating. Since this was an observational study, and factors that may influence the dependent variables were expected to vary by rehabilitation setting, covariates were included in the

regression models to adjust for these factors *prior* to entering the rehabilitation setting variable.

Table 3.4 Summary of Dependent and Independent Variables

Variable Name	Variable Unit(s)	Variable Type	Data Source
Dependent Variables			
Discharge motor functional status (measure of effectiveness)	Motor FIM rating (range: 13 – 91)	Continuous	UDSMR data
Community Discharge (measure of effectiveness)	Discharge to home, board and care, transitional living, or assisted living.	Dichotomous	UDSMR data records
Medicare reimbursement (measure of cost for Medicare Part A program)	U.S. Dollars (1996 and 1997)	Continuous	MedPAR data
Independent Variable			
Rehabilitation Setting	IRF (coded 1) or SNF-based (coded 0) rehabilitation setting	Dichotomous	UDSMR data & MedPAR data

UDSMR refers to the Uniform Data System for Medical Rehabilitation; FIM, Functional Independence Measure, MedPAR, Medicare Provider Analysis and Review; IRF, inpatient rehabilitation facility; SNF, skilled nursing facility

Descriptions and operational definitions, including procedures applied for missing data, for each covariate are provided below. Table 3.5 summarizes valid codes, the definition of outlier values and missing data rules for all variables (i.e., dependent and independent variables and covariates).

Onset Time

The time between the onset of the medical condition (i.e., hip fracture or stroke) and the admission to the rehabilitation program, reported in days. It is calculated

by subtracting the impairment onset date (reported in the UDSMR data file) from the rehabilitation admission date (reported in the MedPAR data file). Valid codes for onset time were 0 to 60 days. For patient records in which the impairment onset was missing or invalid (i.e., onset after admission date), the mean onset time was used as a substitute. As noted in the exclusion criteria, for patients with an onset time greater than 60 days, the onset time was considered an outlier value, and these patients' records were excluded from all data analysis. When onset data were transformed, and a 0 value was undefined by the transformation (i.e., logarithm of 0), the 0 values were recoded to 0.5 (i.e., half of a day).

Admission Motor FIM rating

The patient's motor functional status reported on admission in the UDSMR data file. It was calculated as the sum of the 13 motor FIM item ratings collected during the first 3 days of each patient's rehabilitation stay. Valid codes for this covariate were 13 to 91. Any record with missing motor FIM data was excluded from all analyses.

Admission Cognitive FIM rating

The patient's cognitive functional status reported on admission in the UDSMR data file. It was calculated as the sum of the 5 cognitive FIM item ratings collected during the first 3 days of each patient's rehabilitation stay. Valid codes for this variable were 5 to 35. Any record with missing cognitive FIM ratings was excluded from all analyses.

Table 3.5 Valid Codes, Outlier Definitions, and Treatment of Missing and Invalid Values for Dependent Variables, Independent Variables and Covariates.

Variable Name (Data Source)	Valid Codes	Outlier Definition	Treatment of Missing or Invalid Values
Dependent Variables			
Discharge motor FIM rating (UDSMR)	13 through 91	NA	Record excluded from analysis
Discharge destination (UDSMR)	non-community discharge: 0 community discharge: 1	NA	Discharge destination reported in MedPAR record
Medicare Part A payment (MedPAR) in 1996 and 1997 U.S. Dollars	0 through 100,000	NA	NA
Independent Variable			
Rehabilitation Setting (UDSMR & MedPAR)	IRF=1 or SNF=0	NA	NA
Patient-Level Covariates			
Number of days between onset and rehabilitation admission (UDSMR & MedPAR)	0 through 60	greater than 60 days (see exclusion criteria)	mean substitution
Type of hip fracture using ICD-9-CM codes (UDSMR & MedPAR)	intracapsular:0 extracapsular:1	NA	random substitution based on proportions
Etiologic diagnosis of Stroke using ICD-9-CM codes (UDSMR & MedPAR)	non-hemorrhagic:0 hemorrhagic:1	NA	random substitution based on proportions
Comorbidities or complications: Tier 1 using ICD-9-CM codes (UDSMR & MedPAR)	not present: 0 present: 1	NA	NA
Comorbidities or complications: Tier 2 using ICD-9-CM codes (UDSMR & MedPAR)	not present: 0 present: 1	NA	NA
Comorbidities or complications: Tier 3 using ICD-9-CM codes (UDSMR & MedPAR)	not present: 0 present: 1	NA	NA

Table 3.5 (cont'd)

Variable Name (Data Source)	Valid Codes	Outlier Definition	Treatment of Missing or Invalid Values
Lived alone prior to event (UDSMR)	lived with others: 0 lived alone: 1	NA	NA
Sex (MedPAR)	male: 0 female: 1	NA	random substitution based on proportions
Race/ethnicity (MedPAR)	non-white: 0 white: 1	NA	UDSMR data; then random substitution based on proportions
Admission motor functional status (UDSMR)	13 through 91	NA	excluded record
Admission cognitive functional status (UDSMR)	5 through 35	NA	excluded record
Income (based on patient's ZIP code in (UDSMR)	5,000 through 500,000	NA	1) ZIP code from MedPAR data 2) ZIP code of treating facility 3) county-level median
Age reported in years (MedPAR)	7 through 107	greater than 107	UDSMR data
Market covariates (facility-level)			
Percent of persons in the county with managed care insurance (ARF)	0 through 100 percent	NA	mean substitution
Volume: Number of patients with hip fracture and stroke treated by the facility in a year (UDSMR)	1 through 1000	NA	NA

NA refers to not applicable; FIM, Functional Independence Measure; UDSMR, Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider and Analysis Review; IRF, inpatient rehabilitation facility; SNF, skilled nursing facility; ICD-9-CM, International Classification of Diseases – 9th Revision – Clinical Modification; ZIP, Zone Improvement Plan; ARF, area resource file.

Type of Hip Fracture

For patients with hip fractures, the type of fracture that the patient experienced as reported by the ICD-9-CM codes. The etiologic diagnosis from the UDSMR data was used to identify whether the patient had an intracapsular or extracapsular fracture. If the data were missing from the UDSMR record, the hip fracture code recorded in the MedPAR record was used. Patients with intracapsular fractures were coded as "0," and patients with extracapsular fractures were coded as "1." For the records in which the type of hip fracture was not specified (i.e., ICD-9-CM codes 820.8 or 820.9), random substitution was used based on the distribution of the cases with valid codes.[108]

Type of Stroke

For patients with stroke, the etiologic diagnosis was characterized as non-hemorrhagic (i.e., ischemic) or hemorrhagic based on the ICD-9-CM code recorded as the etiologic diagnosis in the UDSMR records. If these data were missing from the UDSMR record, the ICD-9-CM codes reported in the MedPAR data were used. Patients with non-hemorrhagic strokes were coded "0," and patients with hemorrhagic strokes were coded as "1." For the records in which the type of stroke was not specified, random substitution was used based on the distribution of the cases with valid codes.[108]

Comorbid Conditions

The IRF prospective payment system implemented in 2002 included adjustments for payment based on the presence of comorbidities listed in 3 tiers. The IRF-PPS 3-tiered comorbidity listing was used in this study.

This study used 3 variables to indicate the presence or absence of a comorbidity, one for each tier. If the patient's MedPAR record or UDSMR record included one of the ICD-9-CM codes listed as a tier 1 comorbidity, this covariate was coded as "1." All other records were coded as "0." Likewise, the presence of an ICD-9-CM code listed as either a tier 2 or tier 3 comorbidity was coded as "1" for the respective variable.

If the patient's record indicated that the patient had two or more comorbidities that were listed, only the most serious comorbidity (i.e., lowest tier number) was recognized.

Since the date of medical diagnoses is not reported in either the UDSMR or MedPAR data, it is not certain whether diagnoses reported were present when the patient was admitted, and the diagnoses would be considered comorbidities, or whether the diagnoses occurred after admission, and might be complications of the illness or complications of the treatment, or previously undiagnosed comorbidities.

Age

The patient's age was recorded as reported in the MedPAR data. This variable was calculated by CMS staff as the year of admission minus the year of birth. This meant that each patient became a year older on January 1 rather than on their actual date of birth. Valid codes for this variable were 7 through 107. In one record, the MedPAR data reported the age as 140, and was this considered invalid. The age reported by UDSMR was 40, and was used instead. No data were missing for this variable.

Pre-Hospital Living Alone

The patients' living arrangements prior to the onset of the medical condition (i.e., hip fracture or stroke) were recorded as either alone (coded "1") or with others (coded "0"). Missing data were coded using random substitution based on the valid distributions.

Median Household Income

This variable was based on the median income reported for the patient's residential zip code in 1993 in U.S. Dollars, and was used as a measure of socioeconomic status. The data were obtained from the MapInfo program.[102] If the patient's residential ZIP code was invalid or not included in the MapInfo file, then the median household income associated with the ZIP code of the treating facility was used instead. If the facility ZIP code was invalid or not included in the MapInfo file, then the median income for the facility's county was used.

Sex

The sex of the patient was determined as reported in the MedPAR data. If data were missing from the MedPAR file, the sex of the patient reported in the UDSMR data was used. Males were coded “0,” and females were coded as “1.”

Race/Ethnicity

The race of the patient was coded as white (code 1) or non-white (code 0) based on data reported in the MedPAR file. Non-white included patients with the following race/ethnicity categories: Black, Asian, Native-American, Hispanic, or other.

If race data in the MedPAR data were missing, then the race/ethnicity code reported in the UDSMR data was used as a substitute. If race was not reported in either file, then random substitution based on proportions was used as a substitute.

Volume of Cases

The facility’s volume of cases for each condition was defined as the actual number of cases with stroke or hip fracture treated in the facility. The number of cases included patients from all payer groups for the entire year. No exclusion criteria were applied. Separate values were calculated for 1996 and 1997 using UDSMR (Medicare and non-Medicare) data.

Managed Care Patients in the County

This was determined by the percent of persons in the county of the facility who had a managed care organization providing their medical insurance. This variable was derived from the Area Resource File based on data for the year 1998. Data for 1996 were obtained, but these data assigned the number of members a managed care company reported to the county of the company headquarters. For example, Erie County was assigned 100,000 if a managed care company located in Erie County reported it had 100,000 members. The members' residential county was not considered in these data, and some counties had managed care penetration that was greater than 100 percent (i.e., there were more managed care patients in the county than people living in the county). The 1998 data were based on members' county of residence.

Stratification Variable: Case-Mix Groups

The current IRF prospective payment system (IRF-PPS) assigns patients into a case-mix group based on their impairment group and admission motor and, in some cases, cognitive function and age.[25] These groups are used to determine Medicare reimbursement for the IRF. For patients with hip fracture, there are 5 case-mix groups, and for patients with stroke, there are 14 case-mix groups.

The IRF-PPS Case-Mix Group (CMG) classification system was used in this study to assign patients into smaller, more homogenous groups. For patients

with stroke, the 14 Case-Mix Groups were collapsed into 5 case-mix groups based on the number of cases in each CMG, and admission functional assessment scores.

The criteria for assignment into each of the CMGs are provided in Table 3.6. The labels used in this table and this study were assigned to these case-mix groups for clarity; they are not "official" definitions.

Statistical Analyses

Once the data in the 4 databases (1996 hip fracture database, 1997 hip fracture database, 1996 stroke database, 1997 stroke database) were linked and cleaned, the exclusion criteria were applied. Results of all analyses are reported separately for each database (i.e., year and condition). The outcome and payment analyses are also reported for each condition, with the data from both years combined.

Descriptive statistics were calculated to characterize the patients and facilities included in the study. Statistical tests were employed to identify patient and facility characteristics that were different between IRFs and SNFs. Chi-square tests were used for categorical variables and Mann-Whitney U tests for the continuous variables. Non-parametric Mann-Whitney U tests were used for continuous variables because the data for the variables were not normally

distributed, the variances in the two groups were not always equal, and the numbers of cases in the comparison groups were not equal.[109]

Table 3.6 Case-Mix Group Definitions for IRF-PPS and for this Study

Impairment	IRF-PPS Case-Mix Group	Motor Rating Range (FIM-12)*	Cognitive Rating Range	Age	Case-Mix Group Number and Name Used in this Study**
Stroke	101	69 to 84	23 to 35	all ages	1: Mild disability
	102	59 to 68	23 to 35	all ages	
	103	59 to 84	5 to 22	all ages	
	104	53 to 58	all ratings	all ages	2: Mild to moderate disability
	105	47 to 52	all ratings	all ages	
	106	42 to 46	all ratings	all ages	3: Moderate disability
	107	39 to 41	all ratings	all ages	
	108	34 to 38	all ratings	≥ 83	4: Moderate to severe disability
	109	34 to 38	all ratings	≤ 82	
	110	12 to 33	all ratings	≥ 89	5: Severe disability
	111	27 to 33	all ratings	82 to 88	
	112	12 to 26	all ratings	82 to 88	
	113	27 to 33	all ratings	≤ 81	
	114	12 to 26	all ratings	≤ 81	
Hip Fracture	701	52 to 84	all ratings	all ages	701: Mild disability
	702	46 to 51	all ratings	all ages	702: Mild to moderate disability
	703	42 to 45	all ratings	all ages	703: Moderate disability
	704	38 to 41	all ratings	all ages	704: Moderate to severe disability
	705	12 to 37	all ratings	all ages	705: Severe disability

IRF-PPS refers to inpatient rehabilitation facility prospective payment system.
* The IRF-PPS assigns patients into a case-mix group based on the sum of 12 of the 13 FIM motor items; Tub Transfer was excluded.
** labels were assigned to these case-mix groups for clarity; they are not “official” definitions.

Since FIM instrument data were collected by many clinicians in many settings, the reliability of both the motor and cognitive FIM ratings for each database was assessed using Cronbach’s alpha.[109]

In preparation for regression analyses, the distribution of each continuous variable was examined by reviewing a histogram and inspecting the mean, median, skew and kurtosis for each variable. If indicated, one or more transformations (i.e., logarithm, square root) were applied to each variable based on the procedures recommended by Newton & Rudestam,[108] and Affifi.[110] Formal testing of the normality of the transformed data was then applied by creating a normal probability plot and observing which transformation resulted in the lowest Kolmogorov-Smirnov statistic.

Logistic regression was used to test whether the percent of patients discharged to the community was different for IRFs and SNFs, answering the first and fourth research questions. Multiple linear regression was used to determine whether the discharge motor function status of patients was different if patients received treatment in an IRF or SNF, addressing the second and fifth research questions.

Given the large sample size, small differences in ratings between the two rehabilitation settings were found to be statistically significant. Small differences in ratings may reflect some measurement error as well as true differences in functional status. As reported in the description of the FIM instrument, previous studies comparing FIM scores and minutes of assistance required by persons who are disabled have suggested that an increase of 3 to 5 (motor or cognitive) FIM units was associated with approximately 30 minutes less of daily assistance

from a helper. For this study, differences of 2 or more FIM units were considered to be clinically important differences.

For all regression analyses in this study, the goal of the analysis was to quantify the relationship of the independent variable (i.e., rehabilitation setting) to the dependent variables (i.e., discharge destination and discharge motor FIM rating), after controlling for various patient- and facility-level factors. Therefore, the focus of the analysis was to calculate accurate estimates of the regression coefficients for the independent variable, rather than to create the best prediction model. For this reason, *all* covariates were entered into *each* regression model *prior* to entering the variable of interest, the rehabilitation setting. Kleinbaum[111] refers to this type of regression analysis as a validity-oriented strategy, and Newton and Rudestam[108] call this type of analysis hierarchical regression.

Not all covariates were expected to be important in every regression model. Therefore, it was anticipated that regression models would include one or more covariates that were extraneous variables (i.e., not related to the dependent variable or any of the independent variables). Overfitting a regression model with variables that have true zero regression coefficients in the population does not introduce a bias if the usual regression assumptions are met.[112, 113] Although multicollinearity may be a concern with overfitted models, not including important variables in a model (i.e., an underspecified model) interjects bias in the estimated regression coefficients and standard error.[112, 113] As indicated above,

the goal of the analyses in this study was to make valid, unbiased estimates for the rehabilitation setting variable. The potential for multicollinearity was assessed by examining correlations between each of the transformed covariates and the independent variable.

Each regression analysis began with testing for the presence of effect-measure modifications between the independent variable and 3 of the covariates: 1) admission motor functional status (2-way interaction); 2) age (2-way interaction); 3) living alone prior to the onset of the medical condition (2-way interaction); and 4) admission motor functional status and age (3-way interaction). Effect-measure modification refers to the situation in which the measure of effect changes for different values of a second variable.[114] For example, the effect of rehabilitation setting in predicting discharge functional status may vary depending on whether patients had mild or severe disabilities. When cross-product (i.e., interaction) terms were found to be statistically significant, data were stratified into groups.

Once data were stratified into groups, the distributions of continuous variables were examined again, and transformations, if appropriate, were applied.

As part of the multiple linear regression analyses, the variance inflation factor was calculated to ensure that values were below 4,[113] and thus rule out a potential problem with multicollinearity. To assess the regression assumptions of

normality, equal variance and independence, histograms of the standardized regression residuals for each multiple linear regression model were reviewed to assess whether the residuals were normally distributed around the mean of 0.[113]

Additional analyses were performed to assess whether the study results were biased due to the study methodology and to assess whether results would have been different if alternative sets of exclusion criteria were applied.

To determine whether the study methodology, in particular the linkage procedures, introduced a bias, the UDSMR data were analyzed and the results of the UDSMR data and the linked UDSMR/MedPAR data were compared.

To determine whether an alternative set of exclusion criteria would have led to different results, additional analyses of the UDSMR/MedPAR linked data were executed with 2 sets of alternative exclusion criteria. Results of the study based on the Original Study Exclusion Criteria (i.e., excluding "atypical" stays), and results using the 2 sets of alternative exclusion criteria were compared.

The first set of alternative exclusion criteria, referred to as Exclusion Criteria A, was the same as the Original Study Exclusion Criteria, except that it included the records of patients who had program interruptions, patients who died, and patients who were discharged to acute care hospitals. For the Exclusion Criteria A analyses, the discharge motor FIM ratings of patients who died were recoded

to 13 (i.e., dependent in all motor activities), and the discharge setting was coded as non-community.

The second set of alternative exclusion criteria, called Exclusion Criteria B, applied the Original Study Exclusion Criteria, with the additional exclusion of patients who were younger than 65. Individuals younger than 65 who were Medicare beneficiaries had a long-term disability or renal failure.

When comparing results for the logistic regression analyses, a difference of less than 15 percent between the estimated odd ratios was considered “not different.” For the multiple linear regression analyses, a difference of ± 0.75 FIM units was considered “not different.” If the results were different, the direction of the difference was classified as: 1) toward the null, 2) away from the null, or 3) switchover, when one value was below 1.00, and the other was above 1.00 for logistic regression analyses; and when one value was negative, and the other was positive for the multiple linear regression analyses.

The Mann-Whitney *U* procedure was used to test for differences between Medicare payments made to IRFs and SNFs, addressing the third and sixth research questions. This procedure was used because the payment data for the variables were not normally distributed, the payment data variances in the two groups were not always equal, and the numbers of cases in the comparison

groups were not equal.[109] To control for case-mix differences, data were stratified into case-mix groups, and comparisons were made for each group.

The Medicare payment data are adjustment for various factors, including wage index, indirect medical education, disproportionate share of low-income patients and rural location. Since these adjustments would likely not be equal across the two rehabilitation settings, the payment data were standardized to reflect a wage index of 1.000, and no adjustments for indirect medical education, a disproportionate share of low-income patients, or rural location. For the analyses that combined 1996 and 1997 financial data, the 1996 data were adjusted for inflation to reflect 1997 U.S. Dollars. The procedures used to standardize the payment data are described in detail in Appendix D.

For all analyses, testing was two-sided using an alpha of 0.05.

CHAPTER 4: RESULTS

The results of this study are reported separately by year and condition, and then by condition with the data from the 2 years combined. The first 3 research questions, which relate to the outcomes and cost of rehabilitation care for patients with hip fracture, were addressed using data from the 1996 hip fracture database, the data from the 1997 hip fracture database, and then data from the combined 1996 and 1997 databases. The last 3 research questions, which relate to the care of patients with stroke, were answered using data from the 1996 stroke database, the 1997 stroke database, followed by data from the combined 1996 and 1997 stroke databases.

Results from the 1996 Hip Fracture Database

Application of the Exclusion Criteria – 1996 Hip Fracture Database

The 1996 hip fracture database contained a total of 17,012 patient records that included both clinical (UDSMR) and payment (MedPAR) data. This included 14,494 records describing stays in an Inpatient Rehabilitation Facility (IRF), and 2,518 records describing Skilled Nursing Facility (SNF) stays.

After the study exclusion criteria were applied, 86.1 percent of the IRF records and 78.3 percent of the SNF records remained. As shown in Table 4.1, a significantly higher percent of SNF patient records were excluded from this study

for the following reasons: 1) patients' pre-fracture living setting was not community-based (3.3% for IRFs versus 5.5% for SNFs); 2) patients were admitted to the facility from another rehabilitation facility (2.8% versus 5.4%); 3) patients were discharged to an acute care unit (4.6% and 6.5%); 4) patients died during the rehabilitation stay (0.2% versus 1.1%); 5) patients had a program interruption during the rehabilitation stay (2.5% versus 3.6%); 6) patients' records were missing admission FIM data (0.1% versus 0.8%); and 7) patients' records were missing discharge FIM data (0.1% versus 1.1%).

The final sample for the 1996 hip fracture database was 14,457 patient records, of which 86.4 percent (n = 12,486) represented IRF stays, and 13.6 percent (n = 1,971) were SNF stays.

Figures 4.1 and 4.2 provide a summary of the number of records received from CMS and UDSMR, the number of records that were linked, and the number of records remaining after the exclusion criteria was applied for IRFs (Figure 4.1) and SNFs (Figure 4.2) in the 1996 hip fracture database.

Patient Characteristics – 1996 Hip Fracture Database

The sociodemographic, medical and hospitalization characteristics of the patients included in the 1996 hip fracture database for both rehabilitation settings are reported in Table 4.2.

Table 4.1 Number and Percent of Records of Patients with Hip Fracture not Included in Analysis by Exclusion Criteria for All Cases and by Rehabilitation Setting, 1996. (n = 17,012)

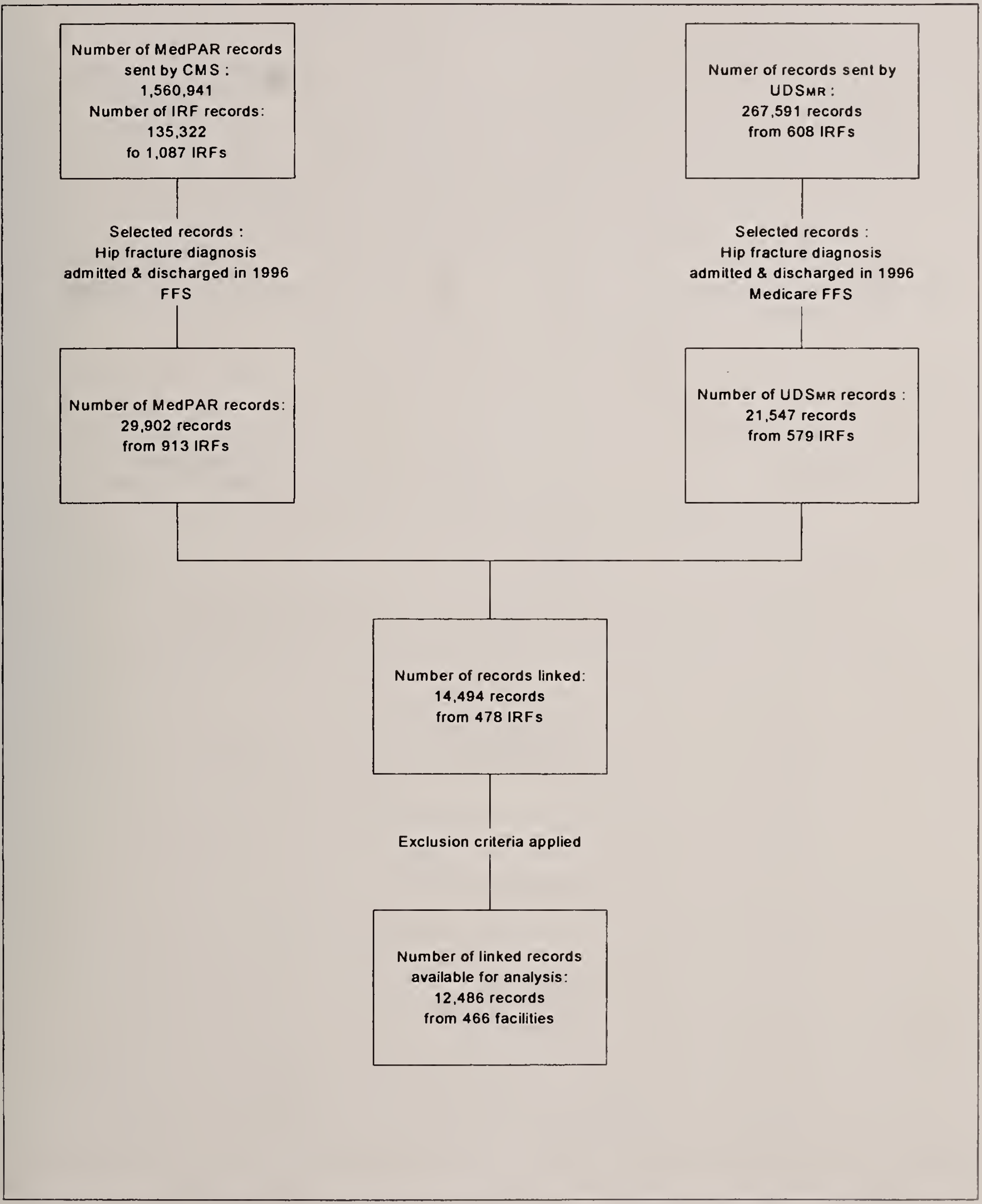
Exclusion Criteria		Inpatient Rehabilitation Facility (n = 14,494)		Skilled Nursing Facility (n=2,518)		P
		n	%	n	%	
1	Patient's pre-fracture living setting was not community-based	482	3.3	139	5.5	< .001
2	The time between the patient's hip fracture and rehabilitation admission was greater than 60 days	107	0.7	20	0.8	.763
3	Patient admitted to rehabilitation facility from another rehabilitation facility, a SNF, or a long-term care hospital	409	2.8	135	5.4	< .001
4	Patient was discharged from rehabilitation facility to an acute care facility	663	4.6	164	6.5	< .001
5	Patient died while in the rehabilitation facility	33	0.2	28	1.1	< .001
6	Patient's rehabilitation length of stay was 3 days or fewer	298	2.1	55	2.2	.677
7	Patient's length of stay was longer than mean plus 3 standard deviations of natural log of length of stay	15	0.1	2	0.1	.724
8	Patient had a program interruption during the rehabilitation stay	364	2.5	90	3.6	.002
9	Admission FIM data was missing from the patient's record	8	0.1	20	0.8	< .001
10	Discharge FIM data was missing from the patient's record	14	0.1	27	1.1	< .001
Total number and percent of records excluded from analyses*		**2,008**	**13.9**	**547**	**21.7**	< .001
Total number and percent of records included in analyses		**12,486**	**86.1**	**1,971**	**78.3**	

* More than one exclusion criterion may apply to an individual patient, thus, n and % columns do not add up to the total number of excluded records

SNF refers to Skilled Nursing Facility; FIM, Functional Independence Measure.

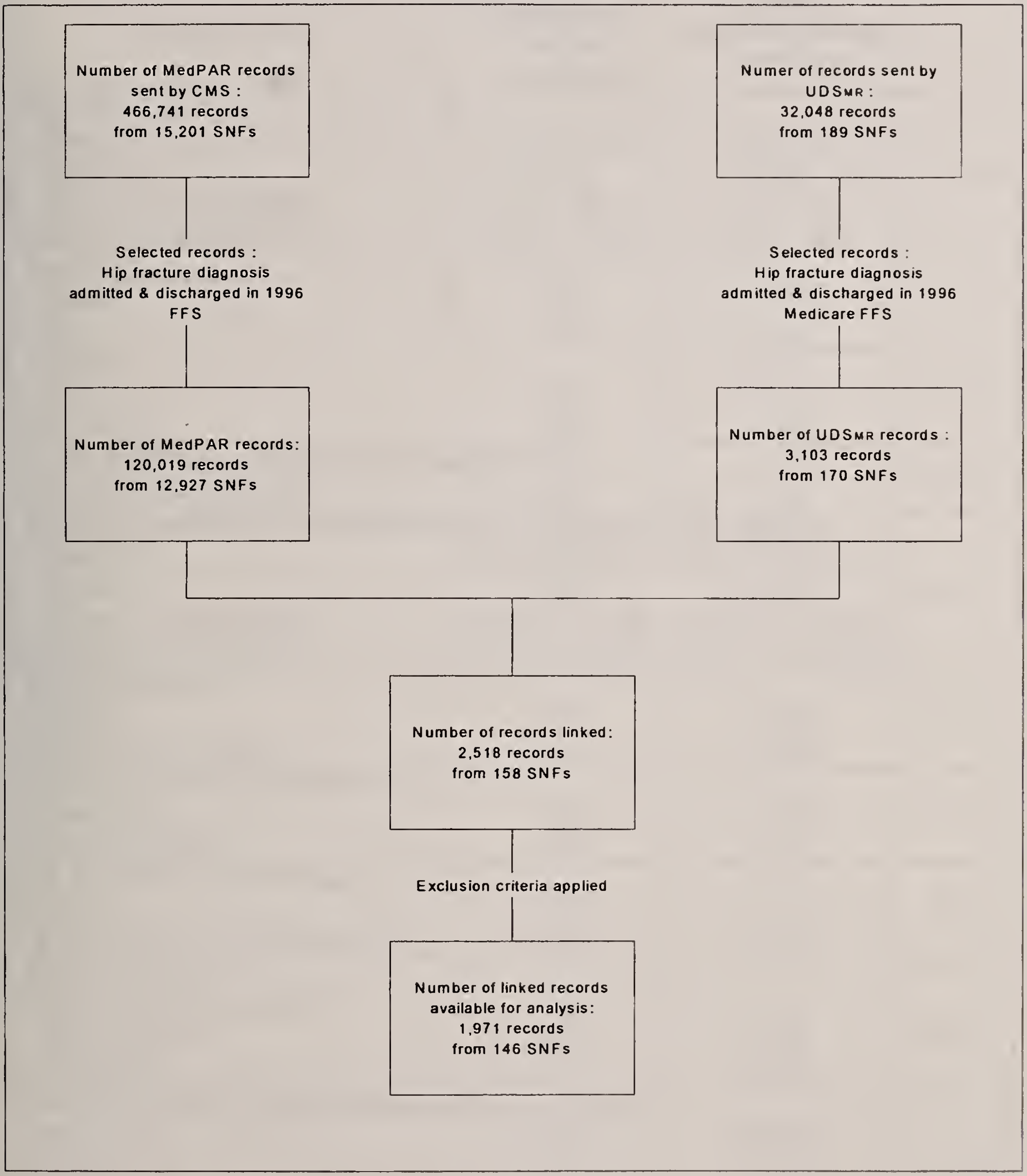
Significance levels determined using Chi-square test.

Figure 4.1 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Inpatient Rehabilitation Facilities, 1996 Hip Fracture.


Number of MedPAR records sent by CMS : 1,560,941 Number of IRF records: 135,322 fo 1,087 IRFs
Numer of records sent by UDSMR : 267,591 records from 608 IRFs
Selected records : Hip fracture diagnosis admitted & discharged in 1996 FFS
Selected records : Hip fracture diagnosis admitted & discharged in 1996 Medicare FFS
Number of MedPAR records: 29,902 records from 913 IRFs
Number of UDSMR records : 21,547 records from 579 IRFs
Number of records linked: 14,494 records from 478 IRFs
Exclusion criteria applied
Number of linked records available for analysis: 12,486 records from 466 facilities

MedPAR refers to Medicare Payment and Review Record; CMS, Centers for Medicare and Medicaid Services; UDSMR, Uniform Data System for Medical Rehabilitation; IRF, Inpatient Rehabilitation Facility; FFS, fee-for-service

Figure 4.2 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Skilled Nursing Facilities, 1996 Hip Fracture


Number of MedPAR records sent by CMS : 466,741 records from 15,201 SNFs
Numer of records sent by UDSMR : 32,048 records from 189 SNFs
Selected records : Hip fracture diagnosis admitted & discharged in 1996 FFS
Selected records : Hip fracture diagnosis admitted & discharged in 1996 Medicare FFS
Number of MedPAR records: 120,019 records from 12,927 SNFs
Number of UDSMR records : 3,103 records from 170 SNFs
Number of records linked: 2,518 records from 158 SNFs
Exclusion criteria applied
Number of linked records available for analysis: 1,971 records from 146 SNFs

MedPAR refers to Medicare Payment and Review Record; CMS, Centers for Medicare and Medicaid Services; UDSMR, Uniform Data System for Medical Rehabilitation; SNF, Skilled Nursing Facility; FFS, fee-for-service

Table 4.2 Sociodemographic, Medical and Hospitalization Characteristics of Patients with Hip Fracture, 1996 (n = 14,457)

Characteristic	Inpatient Rehabilitation Facility (n=12,486)	Skilled Nursing Facility (n=1,971)	P
Age (yr)			< .001
Mean (SD)	80.3 (8.3)	81.9 (7.9)	
Median	81	83	
25th and 75th percentiles	75 – 86	77 – 88	
Minimum and Maximum	26 — 102	33 — 103	
Sex (%)			.012
Female	78.4	80.9	
Male	21.6	19.1	
Race (%)			< .001
White	94.0	96.4	
Non-white	6.0	3.6	
Dually eligible for Medicare and Medicaid (%)			.007
Medicare and Medicaid	8.2	6.4	
Median household income based on ZIP code (1993 U.S. Dollars)			< .001
Mean (SD)	34,231 (13,354)	36,713 (12,161)	
Median	31,564	34,522	
25th and 75th percentiles	24,982 – 40,336	28,225 – 42,480	
Minimum and maximum	5,591 – 134,896	9,752 – 132,656	
Marital status (%)			.037
Married	32.9	30.5	
Not currently married	67.1	69.5	
Lived alone prior to fracture (%)			.430
Lived alone	42.4	43.3	
Lived with others	57.6	56.7	
Pre-hospital living setting (%)			.529
Home	95.5	95.2	
Board & Care, Transitional Living	4.5	4.8	
Admit from (%)			.007
Community-based setting	1.9	1.5	
Acute care unit	96.6	97.8	
Unspecified	1.5	0.7	
Time from onset to rehabilitation admission (days)			< .001
Mean (SD)	7.4 (6.0)	8.2 (7.0)	
Median	6	6	
25th and 75th percentiles	4 – 8	5 – 9	
Minimum and maximum	0 — 60	0 — 59	
Length of rehabilitation stay (days)			< .001
Mean (SD)	16.3 (8.1)	23.7 (15.4)	
Median	15	20	
25th and 75th percentiles	11 – 20	13 – 30	
Minimum and maximum	4 — 72	4 — 124	

Table 4.2 (cont'd)

Characteristic	IRF (n=12,486)	SNF (n=1,971)	P
Time from onset to rehabilitation discharge (days)			< .001
Mean (SD)	23.7 (10.7)	31.9 (17.9)	
Median	21	27	
25th and 75th percentiles	17 – 28	20 – 40	
Minimum and maximum	4 — 119	4 — 135	
Discharge setting (%)			.714
Community	82.1	81.7	
Type of hip fracture (%)			< .001
Extracapsular fracture	62.0	70.0	
Intracapsular fracture	38.0	30.0	
Comorbidities/complications (%)			< .001
Tier 1 (most severe)	0.4	0.2	
Tier 2 (moderately severe)	3.4	3.1	
Tier 3 (mild)	9.3	6.2	
None of listed comorbidities	86.9	90.6	
Case-mix group distribution (%)			< .001
701 – mild disability	19.4	17.7	
702 – mild to moderate disability	25.5	21.7	
703 – moderate disability	15.9	13.0	
704 -- moderate to severe disability	13.2	13.2	
705 – severe disability	26.0	34.3	
Admission motor FIM ratings			< .001
Mean (SD)	45.2 (10.3)	42.9 (11.5)	
Median	46	44	
25th and 75th percentiles	39 – 52	36 - 51	
Minimum and maximum	13 — 85	13 — 85	
Admission cognitive FIM ratings			.701
Mean (SD)	29.0 (6.6)	28.4 (7.7)	
Median	31	31	
25th and 75th percentiles	25 – 35	25 – 35	
Minimum and maximum	5 — 35	5 — 35	
Discharge motor FIM ratings			.005
Mean (SD)	66.8 (13.3)	65.1 (15.7)	
Median	70	69	
25th and 75th percentiles	60 – 77	56 – 77	
Minimum and maximum	13 — 91	13 — 91	
Discharge cognitive FIM ratings			.368
Mean (SD)	30.3 (5.9)	29.8 (6.9)	
Median	33	33	
25th and 75th percentiles	28 – 35	27 – 35	
Minimum and maximum	5 — 35	5 — 35	

P refers to probability; yr, year; SD, standard deviation; ZIP, Zone Improvement Plan; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Significance levels determined using Mann-Whitney *U* and Chi-square tests.

Patients with hip fracture who received rehabilitation services in IRFs, when compared to those treated in SNFs, were younger (median age was 81 for IRFs and 83 for SNFs), were slightly less likely to be female (78.4% versus 80.9%), were more likely to be non-white (6.0% and 3.6%), more likely to be on Medicaid (8.2% and 6.4%), and were slightly more likely to be currently married (32.9% and 30.5%).

The median rehabilitation length of stay for patients in IRFs was shorter than the median stay in SNFs (15 days for IRFs and 20 days for SNFs), and the percentages of community discharges for the two groups were not significantly different (p = .714).

The percent of patients with intracapsular hip fractures was higher in IRFs (38.0% for IRFs and 30.0% for SNFs), and comorbidities/complications were more prevalent among patients in the IRFs (13.1% and 9.5%). Note that these data reflect the characteristics of patients who had typical stays (i.e., after the exclusion criteria were applied).

The distribution of patients by case-mix group was different in the 2 rehabilitation settings, with a slightly higher percentage of patients in the mild severity (701), mild to moderate severity (702) and moderate severity (703) groups receiving

care in an IRF. The percentage of patients in the moderate to severe (704) group was similar in the 2 settings, and the percentage of patients with severe disabilities (705) was higher overall in SNF-based rehabilitation programs.

Consistent with the case-mix group distribution, Table 4.2 shows that the admission and discharge motor FIM ratings were higher for patients in IRFs. A higher motor rating indicates more independence with self-care, bladder and bowel management, transfer and locomotion skills. Cognitive FIM ratings on admission and discharge for the two groups were not significantly different.

Reliability of FIM Ratings – 1996 Hip Fracture Database

The reliability of both the motor and cognitive FIM item ratings was assessed using Cronbach's alpha. Table 4.3 reports the results of these analyses separately for IRF and SNF patient records included in the 1996 hip fracture database.

Among the records of patients treated in IRFs, Cronbach's alpha varied from 0.846 for admission motor FIM ratings to 0.926 for discharge motor FIM ratings. For the records of patients treated in SNFs, the alpha values were slightly higher, and ranged from 0.866 for admission motor FIM ratings to 0.947 for the discharge cognitive FIM ratings. All values were above 0.80, indicating good reliability.[109]

Table 4.3 Cronbach's Alpha for FIM Data by Rehabilitation Setting, Patients with Hip Fracture, 1996 (n = 14,457)

Rating Scale	Inpatient Rehabilitation Facility (n = 12,486)		Skilled Nursing Facility (n = 1,971)	
	Cronbach's Alpha	95% CI	Cronbach's Alpha	95% CI
Admission motor FIM ratings (13 items)	.846	.842 to .850	.866	.857 to .874
Admission cognitive FIM ratings (5 items)	.920	.918 to .922	.948	.945 to .952
Discharge motor FIM ratings (13 items)	.926	.925 to .928	.939	.935 to .943
Discharge cognitive FIM ratings (5 items)	.925	.923 to .927	.947	.943 to .950

FIM refers to Functional Independence Measure; CI, confidence interval

Facility-Level Market Characteristics – 1996 Hip Fracture Database

The 1996 hip fracture database included patient records from 612 facilities, of which 466 (76.1%) were IRFs and 146 (23.9%) were SNFs. As shown in Table 4.4, approximately one-quarter of the IRFs were freestanding facilities, whereas almost 60 percent of SNFs were freestanding facilities.

The most frequent geographic locations for IRFs were the East North Central region (24.5% of facilities) followed by the South Atlantic region (17.8%), and the West South Central region (17.0%). SNFs were most commonly located in the East North Central region (29.5%), the Middle Atlantic region (15.8%), and the Pacific region (13.0%).

Table 4.4 Characteristics of Facilities by Type of Rehabilitation Setting, Patients with Hip Fracture, 1996 (n = 612 facilities)

Facility Characteristic	Inpatient Rehabilitation Facilities (n=466)	Skilled Nursing Facilities (n=146)	P
Type of facility (%)			< .001
Freestanding	26.2	59.6	
Distinct unit	73.8	40.4	
Rural status (%)			.117
Rural	9.7	5.5	
Geographic location* (%)			.014
New England	4.1	6.2	
Middle Atlantic	10.3	15.8	
East North Central	24.5	29.5	
West North Central	7.3	6.8	
South Atlantic	17.8	11.0	
East South Central	4.5	0.7	
West South Central	17.0	9.6	
Mountain	5.6	7.5	
Pacific	9.0	13.0	
Volume: number of patients (all payers)			< .001
Mean (SD)	55.7 (53.5)	29.6 (34.0)	
Median	41.5	17	
25th and 75th percentiles	18 – 75	9.75 – 34.25	
Minimum and maximum	1 — 328	1 — 247	
Managed care penetration in county (%)			< .001
Mean (SD)	27.0 (17.2)	33.9 (16.5)	
Median	26.3	33.4	
25th and 75th percentiles	13.7 – 40.7	25.0 - 45.9	
Minimum and Maximum	0 — 74.8	0 — 74.5	
Patients in facility with managed care insurance (%)			.881
Mean (SD)	5.0 (7.0)	9.3 (14.9)	
Median	2.2	1.7	
25th and 75th percentiles	0 – 7.5	0 – 15.6	
Minimum and Maximum	0 — 53.0	0 — 83	
JCAHO accreditation (self-reported, %)			< .001
Yes	91.4	3.4	
No	8.6	96.6	
CARF accreditation (self-reported, %)			< .001
Yes	70.2	22.6	
No	29.8	77.4	
Number of operating beds			.004
Mean (SD)	35.4 (28.4)	27.8 (20.7)	
Median	25	24	
25th and 75th percentiles	18 – 45	15 – 34.25	
Minimum and Maximum	6 — 270	0 — 123	

Table 4.4 (cont'd)

Characteristic	IRF (n=466)	SNF (n=146)	P
Facility ownership (%)			< .001
Government (Federal, state, county, local)	7.3	2.7	
Non-government, non-church-affiliated, not-for-profit	43.3	23.3	
Church-affiliated, non-government, not-for-profit	22.7	13.7	
Church-affiliated, for profit	0.9	0.0	
For profit, non-church-affiliated	17.4	57.5	
Other, unspecified	8.4	2.8	
Number of records in study analyses			< .001
Mean (SD)	26.8 (32.0)	13.5 (20.0)	
Median	16	7	
25th and 75th percentiles	5 – 36	3 – 15	
Minimum and Maximum	1 — 201	1 — 156	

P refers to probability; SD, standard deviation; JCAHO, Joint Commission on Accreditation of Healthcare Organizations; CARF, Commission on Accreditation of Rehabilitation Facilities; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Significance levels determined using Mann-Whitney *U* and Chi-square tests.
* See Appendix A: Glossary of Terms for a list of the States included in each geographic region.

Facility-Level Market Characteristics – 1996 Hip Fracture Database (cont'd)

In 1996, each IRF in the study provided rehabilitation care to a median of 41.5 patients with hip fracture (all payers), while the SNFs treated a median of 17 patients per facility. Managed care penetration was slightly lower in the counties where IRFs were located, but the percents of patients with managed care treated in IRFs and SNFs were not statistically significantly different (p = .881).

Accreditation was more prevalent in IRFs. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) accredited more than 90 percent of the IRFs, and 3.4 percent of the SNFs.

Approximately 70 percent of the IRFs and 22.6 percent of the SNFs reported that they were accredited by the Commission on Accreditation of Rehabilitation Facilities (CARF).

IRFs reported a higher number of operating beds in their facilities, with half of the IRFs reporting between 18 and 45 beds (25th to 75th percentile), and SNFs reporting 15 to 34.25 beds. In terms of ownership, IRFs were predominantly not-for-profit entities that were not affiliated with a government or church (43.3%), whereas SNFs were predominantly for-profit and non-church affiliated entities (57.5%).

The median number of records included in the analyses of the 1996 hip fracture database was 16 for IRFs, more than double the median number for SNFs, which was 7 records per facility.

Research Question 1: Did the Percentage of Patients with Hip Fracture Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1996?

Preparing Data for Logistic Regression Analyses

Logistic regression was used to test whether the percentage of patients with hip fractures discharged to the community was different for IRFs and SNFs. A community-based discharge was defined as a discharge setting of home (house

or apartment), a board and care setting or a transitional living setting, and was coded as a "1." All other discharge destinations were coded as "0." Covariates were entered into the regression model prior to the rehabilitation setting variable in order to control for differences in patient and facility-level market factors prior to testing the effect of the rehabilitation setting.

The distribution of each continuous covariate was examined. If indicated, data were transformed based on the procedure (e.g., logarithm, square root) which best provided a normal distribution as evidenced by the lowest Kolmogorov-Smirnov statistic.

Correlations between each of the transformed covariates and the independent variable were reviewed to assess for the potential of multicollinearity. All Pearson correlation values were weaker than 0.50; the strongest correlation was 0.47 between the transformed values of the admission motor FIM ratings and the admission cognitive FIM ratings.

The first series of logistic regression models tested for effect-measure modifications (i.e., statistical interaction effects) using cross-product terms. There were no significant interactions between living alone prior to condition onset and rehabilitation setting ($p = .825$). The cross-product term of admission motor FIM ratings and the rehabilitation setting showed borderline significance with a p value of .088.

Statistically significant interaction were found between 1) age and the rehabilitation setting (p = .044), and 2) the 3-way interaction of admission FIM rating, age and rehabilitation setting (p = .003).

Based on these interaction results, the 1996 hip fracture database was stratified into 4 approximately equal groups based on Case-Mix Group assignment and the median age of 82 years. The 4 groups were: 1) the records of patients with mild to moderate disability (Case-Mix Groups 701, 702 and 703) who were 82 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 701, 702 and 703) who were 83 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 704 and 705) who were 82 years of age or younger, 4) and the records of patients with severe disability (Case-Mix Groups 704 and 705) who were 83 years of age or older.

Once data records were stratified into the 4 case-mix/age groups, the distribution of each continuous covariate was examined. If indicated, data were transformed using the procedure that resulted in the lowest Kolmogorov-Smirnov statistic.

Correlations between each of the transformed covariates and the independent variable were reviewed to assess for the potential of multicollinearity. The strongest correlations for the 4 groups were 0.24 (between the transformed values of median household income and managed care penetration) for the first group, 0.27 (between the transformed values of median household income and

managed care penetration) for the second group, 0.40 (between the transformed values of the admission motor FIM ratings and the admission cognitive FIM ratings) for Group 3 and 0.39 (between transformed values of the admission motor FIM ratings and the admission cognitive FIM ratings) for Group 4.

The Percent of Patients Discharged to the Community from Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The percents of community-based discharges for each setting, *prior* to adjusting for the influence of covariates, are reported in Table 4.5. For 3 of the 4 groups, the *unadjusted* percentages of patients discharged to community-based settings from IRFs and SNFs were not significantly different (p = .893 for Group 1, p = .370 for Group 3, p = .127 for Group 4). For Group 2, the difference (85.4% for IRFs and 88.7% for SNFs) showed borderline significance (p = .061).

Table 4.5 Unadjusted Percent of Patients with Hip Fracture Discharged to Community-Based Settings by Rehabilitation Setting, 1996 (n = 14,457)

Group		Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	**Mild to Moderate Disability & age ≤ 82 years**	92.9% (n= 4,744)	92.7% (n = 591)	.893
2	**Mild to Moderate Disability & age ≥ 83 years**	85.4% (n = 2,844)	88.7% (n = 443)	.061
3	**Severe Disability & age ≤ 82 years**	76.0% (n = 2,412)	78.1% (n = 379)	.370
4	**Severe Disability & age ≥ 83 years**	63.6% (n = 2,486)	67.0% (n = 558)	.127

Significance levels determined using Chi-square procedure.

Logistic Regression Analyses of Data in the 1996 Hip Fracture Database

Results of the logistic regression analyses for each of the 4 groups are reported in Tables 4.6, 4.7, 4.8 and 4.9. The coefficients for covariates are reported in these tables, but they are not discussed in this section. Some of the covariates were transformed using terms of an order higher than linear (i.e., squares, cubes), and thus the *b* coefficients for these transformed variables may be unstable.[112] The results for covariates using untransformed data are reported and discussed in Appendix F (Tables F.1 to F.4)

Among younger patients with mild to moderate disability (Group 1), after controlling for covariates, the percentage of patients discharged to community-based settings for the 2 rehabilitation settings was not statistically different (p = .895).

For older patients with mild to moderate disability (Group 2; Table 4.7), after controlling for covariates, the significance level for the rehabilitation setting variable was .050.

Patients in Group 2 treated in IRFs may have been slightly less likely to return to the community than patients in the SNF-based programs; the adjusted odds ratio was 0.72 (95% CI: 0.51 to 1.00).

Table 4.6 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger, 1996 Hip Fracture Database (n = 5,335)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	-0.280	0.208	1.81	0.178	0.76	0.50	1.14
Admission motor FIM rating (*natural logarithm*)	4.452	0.578	59.35	< .001	85.80	27.64	266.33
Admission cognitive FIM rating (*square*)	0.001	0.000	53.65	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.497	0.111	20.11	< .001	0.61	0.49	0.76
Tier 1 comorbidity (present =1)	0.637	1.046	0.37	0.542	1.89	0.24	14.68
Tier 2 comorbidity (present =1)	-0.205	0.299	0.47	0.493	0.81	0.45	1.46
Tier 3 comorbidity (present =1)	0.226	0.208	1.18	0.277	1.25	0.83	1.89
Age (*cube)*	0.000	0.000	5.82	0.016	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-0.647	0.112	33.38	< .001	0.52	0.42	0.65
Median household income (*logarithm base 10*)	-0.236	0.370	0.41	0.524	0.79	0.38	1.63
Sex (female =1)	-0.170	0.147	1.34	0.247	0.84	0.63	1.13
Race (white =1)	0.114	0.257	0.20	0.656	1.12	0.68	1.85
Volume of patients (*logarithm base 10*)	0.222	0.160	1.92	0.166	1.25	0.91	1.71
County managed care penetration (*no transformation*)	-0.117	0.345	0.11	0.735	0.89	0.45	1.75
Rehabilitation setting (IRF=1, SNF=0)	0.024	0.178	0.02	0.895	1.02	0.72	1.45
Constant	-14.10	2.694	27.38	< .001	0.00	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.7 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older, 1996 Hip Fracture Database (n = 3,287)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	0.176	0.192	0.84	0.358	1.19	0.82	1.74
Admission motor FIM rating (*logarithm base 10*)	7.470	1.268	34.69	< .001	1754.9	146.10	21078
Admission cognitive FIM rating (*cube*)	0.000	0.000	39.96	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.223	0.105	4.54	0.033	0.80	0.65	0.98
Tier 1 comorbidity (present =1)	-0.209	0.831	0.06	0.801	0.81	0.16	4.14
Tier 2 comorbidity (present =1)	-0.143	0.311	0.21	0.646	0.87	0.47	1.59
Tier 3 comorbidity (present =1)	0.062	0.247	0.06	0.803	1.06	0.66	1.73
Age (*square root*)	-1.285	0.266	23.26	< .001	0.28	0.16	0.47
Pre-hospital living alone (alone =1)	-0.467	0.109	18.29	< .001	0.63	0.51	0.78
Median household income (*logarithm base 10*)	-0.873	0.355	6.03	0.014	0.42	0.21	0.84
Sex (female =1)	-0.084	0.151	0.31	0.577	0.92	0.68	1.24
Race (white =1)	0.078	0.311	0.06	0.801	1.08	0.59	1.99
Volume of patients (*logarithm base 10*)	0.235	0.155	2.30	0.130	1.26	0.93	1.71
County managed care penetration (*no transformation*)	0.836	0.328	6.49	0.011	2.31	1.21	4.39
Rehabilitation setting (IRF=1, SNF=0)	-0.333	0.170	3.84	0.050	0.72	0.51	1.00
Constant	4.163	3.660	1.29	0.255	64.28	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.8 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger, 1996 Hip Fracture Database (n = 2,791)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time (*logarithm base 10*)	0.292	0.162	3.24	0.072	1.34	0.97	1.84
Admission motor FIM rating (*square*)	0.001	0.000	68.35	< .001	1.00	1.00	1.00
Admission cognitive FIM rating (*square*)	0.001	0.000	22.19	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.173	0.095	3.30	0.069	0.84	0.70	1.01
Tier 1 comorbidity (present =1)	1.430	1.049	1.86	0.173	4.18	0.54	32.66
Tier 2 comorbidity (present =1)	-0.383	0.213	3.21	0.073	0.68	0.45	1.04
Tier 3 comorbidity (present =1)	-0.210	0.127	2.77	0.096	0.81	0.63	1.04
Age (*cube*)	0.000	0.000	2.42	0.120	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-0.460	0.101	20.86	< .001	0.63	0.52	0.77
Median household income (*logarithm base 10*)	-0.518	0.312	2.75	0.097	0.60	0.32	1.10
Sex (female =1)	0.071	0.105	0.46	0.498	1.07	0.87	1.32
Race (white =1)	0.389	0.193	4.05	0.044	1.48	1.01	2.15
Volume of patients (*square root*)	0.026	0.013	3.83	0.050	1.03	1.00	1.05
County managed care penetration (*no transformation*)	-0.159	0.291	0.30	0.585	0.85	0.48	1.51
Rehabilitation setting (IRF=1, SNF=0)	-0.312	0.147	4.54	0.033	0.73	0.55	0.98
Constant	2.235	1.430	2.44	0.118	9.34	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.9 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disabilities (Case-Mix Groups 704 and 705) and 83 Years of Age or Older, 1996 Hip Fracture Database (n = 3,044)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (logarithm base 10)	0.081	0.147	0.30	0.582	1.08	0.81	1.44
Admission motor FIM rating (square)	0.001	0.000	74.74	< .001	1.00	1.00	1.00
Admission cognitive FIM rating (square)	0.001	0.000	25.50	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.307	0.080	14.72	< .001	0.74	0.63	0.86
Tier 1 comorbidity (present =1)	1.605	1.122	2.05	0.153	4.98	0.55	44.91
Tier 2 comorbidity (present =1)	-0.364	0.174	4.36	0.037	0.69	0.49	0.98
Tier 3 comorbidity (present =1)	-0.326	0.143	5.18	0.023	0.72	0.55	0.96
Age (*square*)	-2.749	2.079	1.75	0.186	0.06	0.00	3.77
Pre-hospital living alone (alone =1)	-0.679	0.083	67.46	< .001	0.51	0.43	0.60
Median household income (*logarithm base 10*)	-0.564	0.265	4.52	0.033	0.57	0.34	0.96
Sex (female =1)	-0.046	0.104	0.20	0.657	0.95	0.78	1.17
Race (white =1)	0.050	0.165	0.09	0.761	1.05	0.76	1.45
Volume of patients (*logarithm base 10*)	0.057	0.120	0.22	0.636	1.06	0.84	1.34
County managed care penetration (*no transformation*)	0.362	0.242	2.24	0.135	1.44	0.89	2.31
Rehabilitation setting (IRF=1, SNF=0)	-0.223	0.115	3.77	0.052	0.80	0.64	1.00
Constant	7.450	4.206	3.14	0.077	1719.1	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Transformations made to covariates are reported after the variable name in parentheses.

Among the younger patients with severe disabilities (Group 3; Table 4.8), those treated in IRFs were less likely to return to the community than patients treated in SNFs (p = .033). The adjusted odds ratio for Group 3 was 0.73 (95% CI: 0.55 to 0.98).

Older patients with severe disabilities (Group 4; Table 4.9) treated in IRFs may have been slightly less likely to return to the community than SNF patients (p = .052) after controlling for covariates. The adjusted odds ratio was 0.80, and the 95 percent confidence interval was 0.64 to 1.00.

Post-Hoc Power Analyses for Logistic Regression Results – 1996 Hip Fracture Database

The estimated power of the logistic regression analyses was calculated post-hoc to support interpretations of the results (Table 4.10). For analyses with an alpha of 0.05 and a 5 percent difference in rates considered as clinically important, estimated power was 99 percent for the first group, 84 percent for the second group, and 83 percent for the third group.

For the fourth group, the power was estimated at 59 percent. The significance level of the rehabilitation setting variable for the fourth group was .052, and may have not reached statistical significance at an alpha of .05 because of inadequate power. When the alpha level was increased to .10, power increased to 71 percent.

Table 4.10 Post-Hoc Power Estimates for Logistic Regression Analyses, 1996 Hip Fracture Database (n = 14,457)

Group		IRF: number	SNF: number	Community Discharge – Percent		Alpha	Estimated Power
				low	high		
1	**Mild to Moderate Disability & age ≤ 82 years**	4,744	591	90	95	.05	.99
2	**Mild to Moderate Disability & age ≥ 83 years**	2,844	443	84	89	.05	.84
3	**Severe Disability & age ≤ 82 years**	2,412	379	74	80	.05	.83
4	**Severe Disability & age ≥ 83 years**	2,486	558	63	68	.05	.59
						.10	.71

IRF refers to Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Assessment of Bias in the Logistic Regression Results Due to Methodology

As reported in the methods section, the median percent of UDSMR records linked with MedPAR records was 84.3 for IRFs and 85.7 for SNFs. To determine whether the study methodology, in particular the procedures used to link the data, resulted in biased regression estimates, analyses of the UDSMR data for all patients with hip fracture who had Medicare fee-for-service as their primary payer were conducted. Results of the UDSMR data and the linked UDSMR/MedPAR data were compared. For each of the 4 groups, the odds ratios for the linked data were within ± 15 percent of the UDSMR estimate. The methods used in this study do not appear to have produced biased results for these analyses. The regression estimates and details about the methods used to compare the regression estimates are provided in Appendix G (see Table G.1 for regression estimates).

Results of this study may not reflect the experiences of all patients with hip fracture admitted to IRFs and SNFs that subscribed to the UDSMR, since the analyses included only the records of patients who have typical stays. In the 1996 hip fracture database, 13.9 percent of IRF patients were excluded from analyses due to "atypical" stays or missing data, and 21.7 percent of SNF records were excluded. To determine whether an alternative set of exclusion criteria would have led to different results, additional analyses of the UDSMR/MedPAR linked data were executed with 2 alternative exclusion criteria. Results of the analyses using the Study Exclusion Criteria (i.e., excluding "atypical" stays), and results using the 2 alternative exclusion criteria were compared.

The first set of alternative exclusion criteria, referred to as Exclusion Criteria A, was the same as the Original Study Exclusion Criteria, except that it included the records of patients who had program interruptions, patients who died and patients who were discharged to acute care hospitals. For the Exclusion Criteria A analyses, patients who died were considered to have had a non-community discharge.

The second alternative exclusion criteria, called Exclusion Criteria B, was the same as the Original Study Exclusion Criteria, with the additional exclusion of patients who were younger than 65. Individuals younger than 65 who were

Medicare beneficiaries would have had a long-term (minimum of 2 years) disability or renal failure.

Results of the logistic regression analyses using the Original Study Exclusion Criteria (already reported in Tables 4.6, 4.7, 4.8 and 4.9) and results using Exclusion Criteria A and Exclusion Criteria B are reported in Table H.1 in Appendix H.

The results show that when the records of patients who died, patients who had program interruption and patients who were discharged to acute care were included in the analyses (Exclusion Criteria A), odds ratios were similar (i.e., estimated were within ± 15%) for 3 of the 4 groups. For Group 2, the odds ratio for Exclusion Criteria A was 0.96, and the odds ratio for the Original Study Exclusion Criteria was 0.72. The study exclusion criteria estimate was directed away from the null (i.e., odds ratio of 1.0).

Results that used the Original Study Exclusion Criteria and Exclusion Criteria B were similar (i.e., estimates were within ± 15%).

Summary of Logistic Regression Analyses of the 1996 Hip Fracture Database

In summary, the logistic regression analyses of the 1996 hip fracture database showed that, among patients with mild to moderate disability who were 82 years

old or younger, the percent of patients with hip fractures discharged to community-based settings was not different for IRFs and SNFs.

For patients with severe disabilities who were 82 years old or younger, those treated in SNFs were more likely to be discharged to the community.

Among patients with mild to moderate disabilities who were older than 82 years, and patients with severe disabilities who were older than 82 years, those treated in SNFs may have been slightly more likely to be discharged to the community, but the 95 percent confidence interval for both odds ratios included 1.00. Statistical power was estimated at 84 percent for older patients with mild to moderate disabilities, but only 59 percent for older patients with severe disabilities.

Research Question 2: Did the Functional Outcomes of Patients with Hip Fracture Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1996?

Preparing Data for Multiple Linear Regression Analyses

Multiple linear regression was used to test whether the discharge motor function status of patients with hip fractures was different if the patient received rehabilitation care in an IRF or a SNF. The motor FIM ratings collected within the

last 3 days of a patient's rehabilitation stay were used as the dependent variable in the regression models.

As previously reported, data for some of the variables were transformed, and the Pearson correlations between the independent variable and the covariates were weaker than 0.5. The distribution of the dependent variable, discharge motor FIM ratings, showed a slightly negative skew, but not severe enough to warrant transformation.

As with all regression analyses used in this study, covariates were entered into the regression model prior to the rehabilitation setting variable to control for differences in patient- and facility-level characteristics.

Testing of this hypothesis began with running an analysis of covariance (ANCOVA) to assess whether effect-measure modifications were present. To gauge the importance of any statistical interactions, eta^2 was calculated to estimate the percent of variability explained by the cross-product term.

Statistically significant effect-measure modifications were found between: 1) admission motor FIM ratings and the rehabilitation setting ($p < .001$; $\text{eta}^2 = .002$), 2) living alone prior to condition onset and rehabilitation setting ($p < .001$; $\text{eta}^2 = .001$), and 3) admission motor FIM ratings, age and the rehabilitation setting ($p < .001$; $\text{eta}^2 = .009$).

The cross-product term of age and rehabilitation setting was not statistically significant (p = .779).

Since the 3-way interaction of admission FIM rating, age and setting showed the highest explained variance (i.e., highest eta^2 value), the 1996 hip fracture database was stratified into 4 groups based on Case-Mix Group assignment and the median age of 82 years. The 4 groups, which were the same groups used in the logistic regression analyses, were: 1) the records of patients with mild to moderate disability (Case-Mix Groups 701, 702 and 703) who were 82 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 701, 702 and 703) who were 83 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 704 and 705) who were 82 years of age or younger, 4) and the records of patients with severe disability (Case-Mix Groups 704 and 705) who were 83 years of age or older.

As described previously (in the logistic regression analysis section), some of the continuous variables were transformed, and correlations of the transformed covariates and the independent variable were all weaker than 0.5.

Discharge Motor FIM Ratings of Patients Treated in IRFs and SNFs Prior to Adjusting for Covariates

The *unadjusted* mean, standard deviation and median discharge motor FIM ratings for IRFs and SNFs for each of the 4 groups were calculated (Table 4.11).

These data show statistically significantly different motor FIM ratings for each of the 4 groups. Average *SNF* ratings were higher for the first two groups (i.e., patients with mild to moderate disability), with differences of 0.9 and 1.5 FIM units. Mean *IRF* ratings were higher for the patients with severe disability (Group 3 and Group 4) by differences of 2.1 and 1.9 FIM units.

Table 4.11 Unadjusted Mean, Standard Deviation, and Median Discharge Motor FIM Ratings of Patients with Hip Fractures by Group, 1996 (n = 14,457)

Group		Description	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	**Mild to moderate disability & 82 years of age or younger**	Number	4,744	591	.004
		Mean (SD)	73.9 (7.7)	74.8 (7.8)	
		Median	76	76	
2	**Mild to moderate disability & 83 years of age or older**	Number	2,844	443	< .001
		Mean (SD)	71.1 (8.2)	72.6 (8.4)	
		Median	72	74	
3	**Severe disability & 82 years of age or younger**	Number	2,412	379	.025
		Mean (SD)	59.3 (14.9)	57.2 (15.9)	
		Median	61	59	
4	**Severe disability & 83 years of age or older**	Number	2,486	558	.042
		Mean (SD)	56.1 (14.1)	54.2 (16.4)	
		Median	58	56	

FIM refers to Functional Independence Measure; P, probability; SD, standard deviation
Significance levels determined using Mann-Whitney U procedure.

Given the large sample size, small differences in ratings between the two rehabilitation settings were found to be statistically significant. Small differences in ratings may reflect some measurement error as well as true differences in functional status. As reported in the review of the literature, previous studies comparing FIM ratings and minutes of assistance required by persons who are disabled have suggested that an increase of 3 to 5 (motor and cognitive) FIM units was associated with approximately 30 minutes less of daily assistance from

a helper. Thus, for this study, only differences of 2 or more motor FIM units were considered clinically important.

In the analyses of the unadjusted discharge motor FIM ratings, statistically significant results were detected for all 4 groups, but the differences between the median ratings were less than 2 FIM units for 3 of the 4 groups. For Group 3, IRF ratings were higher by 2.1 FIM units.

Multiple Linear Regression Results -- 1996 Hip Fracture Database

Results of the multiple regression analyses for each of the 4 case-mix/age groups are reported in tables 4.12, 4.13, 4.14 and 4.15.

As with other regression analyses, the coefficients for covariates are reported in these tables, but are not discussed. Some data have been transformed, and coefficients for these variables may be unstable.[112] The results for covariates using untransformed data are reported and discussed in Appendix F (Tables F.9 to F.12).

For the patients with mild to moderate disability who were 82 years of age and younger (Group 1; Table 4.12), after controlling for covariates, a statistically significant effect of -0.75 was detected (p = .014; 95% CI: -1.34 to -0.15; R^2 change = .001). Thus, SNF patients achieved higher mean discharge FIM ratings of less than 1 point compared to patients treated in IRFs.

For the patients with mild to moderate disability who were 83 years of age and older (Group 2; Table 4.13) a statistically significant effect of -1.35 was detected ($p = < .001$; 95% CI: -2.10 to -0.60; R^2 change = .003). These results indicate that, after adjusting for covariates, patients discharged from SNFs achieved a higher discharge FIM rating of approximately 1.4 points when compared to patients discharged from IRFs.

After controlling for covariates, no statistically significant effect was detected for the patients in the third ($p = .695$) or fourth ($p = .739$) groups, those who had severe disabilities and were 82 years of age and younger (Table 4.14), and those patients with severe disability who were 83 years of age and older (Table 4.15), respectively.

Multicollinearity did not appear to be a concern for any of the multiple regression models used; the highest variance inflation factor values within each model were 1.138 for Group 1, 1.139 for Group 2, 1.223 for Group 3 and 1.222 for the last group. These values are below the value of 4, which could indicate a potential problem.[113]

Histograms of the standardized regression residuals for each model showed residuals were generally normally distributed, addressing the regression assumption of normality.[113]

Table 4.12 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger, 1996 Hip Fracture Database (n = 5,335)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	-31.93	4.13	--	-7.73	< .001	-40.02	-23.83
Onset time (*logarithm base 10*)	-1.76	0.36	-0.06	-4.95	< .001	-2.46	-1.06
Admission motor FIM rating (*natural logarithm*)	24.12	0.84	0.36	28.64	< .001	22.47	25.77
Admission cognitive FIM rating (*square*)	0.01	0.00	0.23	18.82	< .001	0.01	0.01
Type of hip fracture (Extracapsular fracture = 1)	-0.82	0.20	-0.05	-4.22	< .001	-1.21	-0.44
Tier 1 comorbidity (present =1)	-2.60	1.55	-0.02	-1.68	0.093	-5.63	0.43
Tier 2 comorbidity (present =1)	-0.56	0.59	-0.01	-0.94	0.347	-1.72	0.61
Tier 3 comorbidity (present =1)	-0.40	0.34	-0.01	-1.17	0.241	-1.06	0.27
Age (*cube*)	0.00	0.00	-0.01	-1.04	0.296	0.00	0.00
Pre-hospital living alone (alone =1)	1.16	0.19	0.07	6.05	< .001	0.78	1.53
Median household income (*logarithm base 10*)	1.11	0.62	0.02	1.80	0.072	-0.10	2.32
Sex (female = 1)	-0.06	0.23	0.00	-0.27	0.788	-0.52	0.39
Race (white = 1)	0.60	0.42	0.02	1.42	0.157	-0.23	1.42
Volume of patients (*logarithm base 10*)	0.36	0.27	0.02	1.30	0.193	-0.18	0.89
County managed care penetration (*no transformation*)	-0.21	0.59	0.00	-0.35	0.729	-1.37	0.96
Rehabilitation setting (IRF = 1, SNF = 0)	-0.75	0.30	-0.03	-2.46	0.014	-1.34	-0.15

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.13 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older, 1996 Hip Fracture Database (n = 3,287)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	-0.11	8.88	--	-0.01	0.990	-17.52	17.31
Onset time (*logarithm base 10*)	-1.91	0.47	-0.06	-4.07	< .001	-2.83	-0.99
Admission motor FIM rating (*logarithm base 10*)	62.23	2.78	0.35	22.36	< .001	56.77	67.68
Admission cognitive FIM rating (*cube*)	0.00	0.00	0.23	14.39	< .001	0.00	0.00
Type of hip fracture (Extracapsular fracture = 1)	-1.12	0.26	-0.07	-4.29	< .001	-1.63	-0.61
Tier 1 comorbidity (present =1)	0.42	2.40	0.00	0.17	0.862	-4.29	5.12
Tier 2 comorbidity (present =1)	0.16	0.83	0.00	0.19	0.848	-1.47	1.79
Tier 3 comorbidity (present =1)	-0.16	0.58	0.00	-0.28	0.778	-1.30	0.98
Age (*square root*)	-3.99	0.69	-0.09	-5.77	< .001	-5.35	-2.64
Pre-hospital living alone (alone =1)	1.36	0.26	0.08	5.22	< .001	0.85	1.87
Median household income (*logarithm base 10*)	-0.08	0.85	0.00	-0.09	0.928	-1.74	1.59
Sex (female = 1)	-0.04	0.36	0.00	-0.12	0.908	-0.74	0.66
Race (white = 1)	0.65	0.70	0.01	0.92	0.359	-0.73	2.02
Volume of patients (*logarithm base 10*)	0.09	0.38	0.00	0.24	0.807	-0.65	0.84
County managed care penetration (*no transformation*)	1.06	0.79	0.02	1.35	0.177	-0.48	2.61
Rehabilitation setting (IRF = 1, SNF = 0)	-1.35	0.38	-0.06	-3.52	< .001	-2.10	-0.60

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.14 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger, 1996 Hip Fracture Database (n = 2,791)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	20.07	6.59	--	3.05	0.002	7.15	32.98
Onset time (*logarithm base 10*)	-2.52	0.77	-0.05	-3.28	0.001	-4.03	-1.02
Admission motor FIM rating (*square*)	0.02	0.00	0.48	30.83	< .001	0.02	0.02
Admission cognitive FIM rating (*square*)	0.01	0.00	0.25	15.69	< .001	0.01	0.01
Type of hip fracture (Extracapsular fracture = 1)	-0.18	0.45	-0.01	-0.40	0.690	-1.05	0.70
Tier 1 comorbidity (present =1)	-0.51	2.76	0.00	-0.18	0.854	-5.92	4.91
Tier 2 comorbidity (present =1)	-1.49	1.07	-0.02	-1.39	0.165	-3.59	0.61
Tier 3 comorbidity (present =1)	-2.59	0.61	-0.06	-4.26	< .001	-3.78	-1.40
Age (*cube*)	0.00	0.00	-0.01	-0.41	0.679	0.00	0.00
Pre-hospital living alone (alone =1)	3.15	0.48	0.10	6.62	< .001	2.22	4.08
Median household income (*logarithm base 10*)	2.46	1.43	0.03	1.71	0.087	-0.36	5.27
Sex (female = 1)	0.31	0.49	0.01	0.63	0.531	-0.65	1.26
Race (white = 1)	-1.09	0.81	-0.02	-1.34	0.179	-2.69	0.50
Volume of patients (*square root*)	0.06	0.06	0.01	0.95	0.343	-0.06	0.18
County managed care penetration (*no transformation*)	-0.33	1.35	0.00	-0.24	0.810	-2.98	2.33
Rehabilitation setting (IRF = 1, SNF = 0)	0.26	0.66	0.01	0.39	0.695	-1.04	1.56

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.15 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older, 1996 Hip Fracture Database (n = 3,044)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	149.7	20.69	--	7.24	< .001	109.13	190.26
Onset time (*logarithm base 10*)	-3.10	0.72	-0.06	-4.29	< .001	-4.51	-1.68
Admission motor FIM rating (*square*)	0.02	0.00	0.50	34.47	< .001	0.02	0.02
Admission cognitive FIM rating (*square*)	0.01	0.00	0.25	17.34	< .001	0.01	0.01
Type of hip fracture (Extracapsular fracture = 1)	-0.55	0.40	-0.02	-1.40	0.162	-1.33	0.22
Tier 1 comorbidity (present =1)	-0.37	4.38	0.00	-0.08	0.933	-8.95	8.21
Tier 2 comorbidity (present =1)	-1.50	0.89	-0.02	-1.69	0.091	-3.23	0.24
Tier 3 comorbidity (present =1)	-1.17	0.72	-0.02	-1.61	0.107	-2.59	0.25
Age (*square*)	-68.99	10.23	-0.09	-6.74	< .001	-89.05	-48.92
Pre-hospital living alone (alone =1)	1.74	0.40	0.06	4.31	< .001	0.95	2.53
Median household income (*logarithm base 10*)	3.07	1.30	0.03	2.37	0.018	0.53	5.61
Sex (female = 1)	0.15	0.51	0.00	0.30	0.762	-0.84	1.14
Race (white = 1)	-0.49	0.80	-0.01	-0.62	0.538	-2.06	1.08
Volume of patients (*logarithm base 10*)	0.63	0.59	0.02	1.07	0.285	-0.52	1.78
County managed care penetration (*no transformation*)	-0.63	1.19	-0.01	-0.53	0.596	-2.96	1.70
Rehabilitation setting (IRF = 1, SNF = 0)	-0.18	0.55	0.00	-0.33	0.739	-1.27	0.90

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Post-Hoc Power Analyses for Multiple Linear Regression Results – 1996 Hip Fracture Database

The estimated power of each analysis was calculated post-hoc to assist with interpretation of the results. As shown in Table 4.16, the estimated power for these analyses with an alpha of 0.05 and small effect size (i.e., incremental R^2 of .005), was 99 percent for all 4 groups.

Table 4.16 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1996 Hip Fracture Database (n = 14,457)

Group		Number of Patient Records	Adjusted R^2	Effect Size: Incremental R^2 Increase	Alpha	Estimated Power
1	**Mild to Moderate Disability & age ≤ 82 years**	5,335	.237	.005	.05	.99
2	**Mild to Moderate Disability & age ≥ 83 years**	3,287	.240	.005	.05	.99
3	**Severe Disability & age ≤ 82 years**	2,791	.437	.005	.05	.99
4	**Severe Disability & age ≥ 83 years**	3,044	.464	.005	.05	.99

R^2 refers to multiple coefficient of determination

Assessment for Bias in Multiple Linear Regression Results Due to Methodology

In the 1996 hip fracture database, the median percent of records linked was 84.3 for IRFs and 85.7 for SNFs. To determine whether the study methodology, including the procedures used to link the data, resulted in biased regression estimates, analyses of all the UDSMR data for Medicare fee-for-service patients

with hip fracture were conducted. Results using the UDSMR data and results using the linked UDSMR/MedPAR data were compared.

The regression estimates, reported in Appendix G (Table G.2), did not appear to show any obvious bias. For 3 of the 4 groups, estimates were similar (within ± 0.75 FIM units). For Group 2, the effect of the rehabilitation setting was –2.17 for the UDSMR data, and –1.35 for the linked data. The coefficient for the linked data was directed toward the null (i.e., closer to the difference of 0.0 units).

Results of the multiple linear regression may not reflect the experiences of all patients with hip fracture admitted to IRFs and SNFs that subscribed to the UDSMR, since the analyses included only the records of patients who have typical stays. In the 1996 hip fracture database, 13.9 percent of IRF records and 21.7 percent of SNF records were excluded from analyses because they were considered "atypical" stays. To determine whether an alternative set of exclusion criteria would have changed results, additional analyses of the UDSMR/MedPAR linked data were executed with 2 alternative exclusion criteria. Results of the study using the Original Study Exclusion Criteria (i.e., excluding "atypical" stays), and results using the 2 alternative exclusion criteria were compared.

The first set of alternative exclusion criteria, referred to as Exclusion Criteria A, was the same as the Original Study Exclusion Criteria, except that it included the records of patients who had program interruptions, patients who died and

patients who were discharged to acute care hospitals. For the Exclusion Criteria A analyses, the discharge motor FIM ratings of patients who died were recoded to 13 (i.e., dependent in all motor activities).

The second set of alternative exclusion criteria, called Exclusion Criteria B, was the same as the Original Study Exclusion Criteria, with the additional exclusion of patients who were younger than 65. Individuals younger than 65 who are Medicare beneficiaries have a disability or have renal failure.

Results of the multiple linear regression analyses using the Study Exclusion Criteria (reported in Tables 4.12, 4.13, 4.14 and 4.15) and results using Exclusion Criteria A and Exclusion Criteria B are reported in Table H.2 of Appendix H.

A comparison of Exclusion Criteria A and the Original Study Exclusion Criteria for each of the 4 groups showed that the regression coefficients were similar (i.e., within ± 0.75 FIM units). The regression coefficients for all groups were also similar (i.e., within ± 0.75 FIM units) when Exclusion Criteria B and the Original Study Exclusion Criteria were applied.

Summary of Multiple Linear Regression Analyses of the 1996 Hip Fracture Database

In summary, the discharge motor FIM ratings for patients with mild to moderate disability were statistically significantly higher for those patients treated in SNFs, however, the differences were small (i.e., less than 2 FIM units), and may not be clinically important. For patients with hip fracture who had severe disabilities on admission, the discharge motor FIM ratings were not different.

Research Question 3: Did Medicare Payments for Patients with Hip Fracture Treated in IRFs Differ from Medicare Payments for Patients Treated in SNF-Based Rehabilitation Care Across All Case-Mix Groups in 1996?

Payments to Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facility (SNFs) – 1996 Hip Fracture Database

In the 1996 hip fracture database, the median unadjusted Medicare Part A payment per patient was $9,366 for IRFs and $6,205 (both in 1996 U.S. Dollars) for SNF-based rehabilitation programs.

When payment amounts were standardized to reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education, the difference remained statistically significant. The

median standardized payment per patient to IRFs was $9,591, and the median payment per patient to SNF-based rehabilitation programs was $5,988, a difference of $3,603 (median IRF payment was 60.2% higher than the median SNF payment).

The sum of payments received by the facility from Medicare Part A, other primary payers and patients, was $9,600 for patients discharged from IRFs and $6,628 for patients discharged from SNF-based rehabilitation programs.

For some rehabilitation stays, patients were responsible for paying (either out-of-pocket or through a Medigap provider) a deductible, co-insurance or a blood deductible. Approximately 85.7 percent of IRF patients and 50.9 percent of SNF patients had no liability.

The payment data described above, as well as additional statistics for each payment variable, including the mean, standard deviation, median, 25th and 75th percentile and minimum and maximum amounts, are reported in Table 4.17. P values reported in the table are based on the Mann-Whitney *U* test.

Medicare Payments and Length of Stay by Case-Mix Group – 1996 Hip Fracture Database

When payment data were analyzed by Case-Mix Group (Table 4.18), the unadjusted and standardized Medicare Part A payments remained statistically significantly different across all 5 groups, with IRF payments always higher.

Table 4.17 Medicare Part A Payment Data for Fee-for-Service Patients with Hip Fracture by Rehabilitation Setting, 1996 (n = 14,457)

Type of Payment	Inpatient Rehabilitation Facility (n=12,486)	Skilled Nursing Facility (n=1,971)	P
Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
Mean (SD)	10,495 (6,070)	7,401 (5,241)	
Median	9,366	6,205	
25th and 75th percentiles	6,465 – 13,323	4,035 – 9,460	
Minimum and maximum	0 — 53,954	0 — 37,260	
Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
Mean (SD)	10,880 (6,483)	7,240 (5,197)	
Median	9,591	5,988	
25th and 75th percentiles	6,578 – 13,799	3,927 – 9,149	
Minimum and maximum	0 — 61,901	0 — 37,401	
Payments to facility (1996 U.S. Dollars)*			< .001
Mean (SD)	10,760 (6,111)	8,205 (6,046)	
Median	9,600	6,628	
25th and 75th percentiles	6,651 – 13,497	4,164 – 10,384	
Minimum and Maximum	0 — 89,151	0 — 42,504	
Patient liability (1996 U.S. Dollars)			< .001
Patients with liability (%)	85.7	50.9	
Mean (SD)	131 (505)	715 (1,208)	
Median	0	0	
25th and 75th percentiles	0 – 0	0 – 1,012	
Minimum and maximum	0 — 18,400	0 — 7,600	

SD refers to standard deviation.
Significance levels determined using Mann-Whitney *U* procedure.
Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education. Patient liability includes co-insurance and deductibles.
* Payments from Medicare Part A, other primary payers and patients; does not include payments from Medicare Part B.

As the Case-Mix Groups increased in severity (i.e., from 701 to 705), the difference in the standardized payment also tended to increase. For Case-Mix Group 701, the difference between the median IRF payment and the median

SNF payment was $3,106; the IRF payment was 74.2% higher than SNF payment.

Table 4.18 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Hip Fracture by Case-Mix Group and by Rehabilitation Setting, 1996 (n = 14,457)

Case-Mix Group	Variable	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
701	**Number of patient records**	**2,419**	**349**	
	Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
	Mean (SD)	7,763 (4,250)	5,047 (3,605)	
	Median	7,147	4,422	
	25th and 75th percentiles	4,938 – 9,750	2,570 – 6,734	
	Minimum and maximum	0 — 30,667	0 — 26,842	
	Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
	Mean (SD)	7,884 (4,349)	5,072 (3,681)	
	Median	7,294	4,188	
	25th and 75th percentiles	5,042 – 9,783	2,572 – 6,991	
	Minimum and maximum	0 — 35,097	0 — 31,335	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	12.5 (6.0)	17.2 (11.2)	
	Median	11	14	
	25th and 75th percentiles	8 – 15	9 – 21	
	Minimum and maximum	4 — 56	4 — 77	
702	**Number of patient records**	**3,185**	**428**	
	Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
	Mean (SD)	9,226 (4,991)	6,447 (3,920)	
	Median	8,490	5,870	
	25th and 75th percentiles	6,030 – 11,511	3,946 – 8,280	
	Minimum and maximum	0 — 39,164	0 — 31,352	
	Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
	Mean (SD)	9,524 (5,271)	6,471 (4,029)	
	Median	8,661	5,630	
	25th and 75th percentiles	6,179 – 11,912	3,879 – 8,172	
	Minimum and maximum	0 — 43,145	0 — 32,389	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	14.7 (6.6)	21.5 (12.6)	
	Median	14	19	
	25th and 75th percentiles	10 – 18	13 – 28	
	Minimum and maximum	4 — 64	4 — 87	

Table 4.18 (cont'd)

Case-Mix Group	Variable	IRF	SNF	P
703	**Number of patient records**	**1,984**	**257**	
	Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
	Mean (SD)	10,607 (5,477)	6,940 (4,318)	
	Median	9,750	5,864	
	25th and 75th percentiles	7,004 – 13,383	4,186 – 9,285	
	Minimum and maximum	0 — 40,704	0 — 29,042	
	Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
	Mean (SD)	11,001 (5,846)	6,825 (4,186)	
	Median	10,027	5,930	
	25th and 75th percentiles	7,072 – 13,993	4,093 – 8,371	
	Minimum and maximum	0 — 42,935	0 — 26,671	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	16.6 (7.1)	23.2 (14.9)	
	Median	15	20	
	25th and 75th percentiles	11 – 21	13 – 29	
	Minimum and maximum	4 — 67	4 — 99	
704	**Number of patient records**	**1,651**	**261**	
	Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
	Mean (SD)	11,823 (6,178)	7,678 (4,640)	
	Median	10,768	6,750	
	25th and 75th percentiles	7,722 – 14,782	4,719 – 9,952	
	Minimum and maximum	0 — 51,940	0 — 27,467	
	Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
	Mean (SD)	12,324 (6,639)	7,314 (4,592)	
	Median	11,120	6,226	
	25th and 75th percentiles	7,845 – 15,542	4,312 – 9,001	
	Minimum and maximum	0 — 56,103	0 — 28,693	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	18.1 (8.0)	24.6 (13.5)	
	Median	16	22	
	25th and 75th percentiles	13 – 22	15 – 31	
	Minimum and maximum	4 — 72	4 — 100	

Table 4.18 (cont'd)

Case-Mix Group	**Variable**	**IRF**	**SNF**	**P**
705	**Number of patient records**	**3,247**	**676**	
	Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
	Mean (SD)	13,030 (7,185)	9,289 (6,423)	
	Median	11,730	7,730	
	25th and 75th percentiles	8,144 – 16,455	4,800 – 11,802	
	Minimum and maximum	0 — 53,954	0 — 37,260	
	Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
	Mean (SD)	13,635 (7,736)	8,975 (6,396)	
	Median	12,178	7,366	
	25th and 75th percentiles	8,484 – 16,955	4,769 – 11,165	
	Minimum and maximum	0 — 61,901	0 — 37,401	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	19.7 (9.5)	28.3 (18.1)	
	Median	18	23	
	25th and 75th percentiles	13 – 24	16 – 36	
	Minimum and maximum	4 — 72	4 — 124	

SD = standard deviation
Significance levels determined using Mann-Whitney *U* procedure.
Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education.

The difference increased slightly to $3,031 (53.8% higher than SNF payment) for Case-Mix Group 702, $4,097 (69.1% higher than SNF payment) for Case-Mix Group 703, $4,894 (78.6% higher than SNF payment) for Case-Mix Group 704, and decreased slightly to $4,812 (65.3% higher than SNF payment) for Case-Mix Group 705.

Across each Case-Mix Group, the rehabilitation length of stay (LOS) was significantly shorter for patients in IRFs when compared to patients with stays in SNFs. For patients in Case-Mix Group 701, the median LOS was 11 days for IRFs and 14 days for SNFs, a difference of 3 days. For the remaining Case-Mix Groups, the median stays for IRFs and SNFs were 14 and 19 days for Case-Mix

Group 702 (a difference of 5 days), 15 and 20 days for Case-Mix Group 703 (a difference of 5 days), 16 and 22 days for Case-Mix Group 704 (a difference of 6 days) and 18 and 23 days for Case-Mix Group 705 (a difference of 5 days).

Summary of Medicare Payment Analyses – 1996 Hip Fracture Database

In summary, Medicare Part A payments to IRFs were found to be significantly higher than payments made to SNFs for patients with hip fracture in 1996 using the Mann-Whitney *U* procedure. Differences between the median standardized payments remained when data were stratified into the 5 Case-Mix Groups, ranging from $3,106 for Case-Mix Group 701 to $4,894 for Case-Mix Group 704.

Although payments to IRFs were higher, the median stays for patients in IRFs were significantly shorter than the stays for patients in SNFs when stratified by Case-Mix Group.

Results – 1997 Hip Fracture Database

Application of Exclusion Criteria -- 1997 Hip Fracture Database

The records of 18,442 patients with hip fracture who had rehabilitation stays in 1997 were linked to include functional status and payment data. As shown in Table 4.19, once the exclusion criteria were applied, 83.9 percent of IRF patient records and 80.4 percent of SNF records remained.

A significantly higher percentage of IRF records was excluded because the patients' pre-fracture living setting was not community-based (5.3% for IRFs and. 3.8% for SNFs).

A significantly higher percentage of SNF records was excluded for the following reasons: 1) patients were admitted to the SNF from another rehabilitation facility (2.9% for IRFs and 6.9% for SNFs); 2) patients died during the rehabilitation stay (0.3% and 1.3%); 3) patients had a program interruption (2.4% and 3.5%); and 4) discharge FIM data were missing in the patients' records (0.2% and 0.9%).

The final sample for the 1997 hip fracture database was 15,336 records, of which 79.7 percent (n = 12,228) represented IRF stays, and 20.3 percent (n = 3,108) SNF stays.

Table 4.19 Number and Percent of Records of Patients with Hip Fracture not Included in Analyses by Exclusion Criteria for All Cases and by Rehabilitation Setting, 1997 (n = 18,442)

Exclusion Criteria		Inpatient Rehabilitation Facility (n =14,576)		Skilled Nursing Facility (n=3,866)		P
		n	%	n	%	
1	Patient's pre-fracture living setting was not community-based	777	5.3	148	3.8	< .001
2	The time between the patient's fracture and rehabilitation admission was greater than 60 days	87	0.6	30	0.8	.212
3	Patient admitted to rehabilitation facility from another rehabilitation facility, a SNF, or a long-term care hospital	429	2.9	267	6.9	< .001
4	Patient was discharged from rehabilitation facility to an acute care facility	715	4.9	195	5.0	.723
5	Patient died while in the rehabilitation facility	45	0.3	50	1.3	< .001
6	Patient's rehabilitation length of stay was 3 days or fewer	339	2.3	76	2.0	.180
7	Patient's length of stay was longer than mean plus 3 standard deviations of natural log of length of stay	20	0.1	3	0.1	.350
8	Patient had a program interruption during the rehabilitation stay	353	2.4	135	3.5	< .001
9	Admission FIM data was missing from the patient's record	20	0.1	10	0.3	.096
10	Discharge FIM data was missing from the patient's record	31	0.2	33	0.9	< .001
Total number and percent of records excluded from analyses*		**2,348**	**16.1**	**758**	**19.6**	< .001
Total number and percent of records included in analyses		**12,228**	**83.9**	**3,108**	**80.4**	

* More than one exclusion criterion may apply to an individual patient, thus, n and % columns do not add up to the total number of excluded records

SNF refers to Skilled Nursing Facility; FIM, Functional Independence Measure.

Significance levels determined using Chi-square test.

Figures 4.3 and 4.4 provide a summary of the number of records received from CMS and UDSMR, the number of records that were linked, and the number of records remaining after the exclusion criteria was applied for IRFs (Figure 4.3) and SNFs (Figure 4.4) in the 1997 hip fracture database.

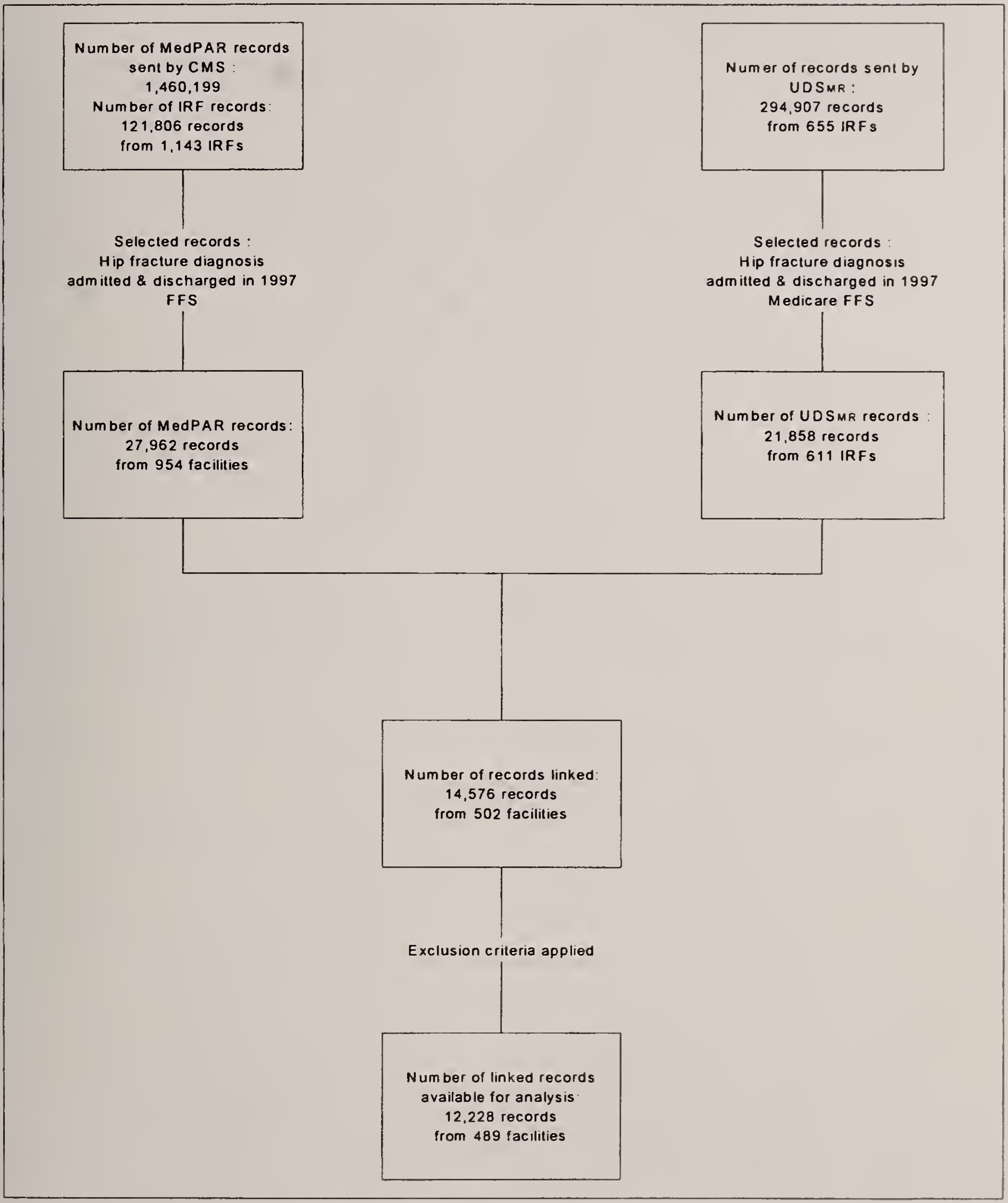
Patient Characteristics – 1997 Hip Fracture Database

In comparing patients admitted to IRFs and SNFs (Table 4.20), IRF patients were slightly younger (median age of 81 for IRF patients versus 83 for SNF patients), slightly less likely to be female (77.6% versus 79.9%), more likely to be non-white (6.7% versus 3.6%), more likely to be on Medicaid (8.6% versus 6.3%), and slightly more likely to be currently married (33.1% versus 29.2%), respectively.

The time between the hip fracture and the admission to rehabilitation was slightly shorter for IRF patients who had a median onset time of 5 days, whereas SNF patients had a median onset time of 6 days. The median length of the rehabilitation stay was shorter for IRF patients at 14 days than the median stay in SNFs of 20 days. The percent of patients discharged to the community for the 2 types of rehabilitation programs was not significantly different (p = .474).

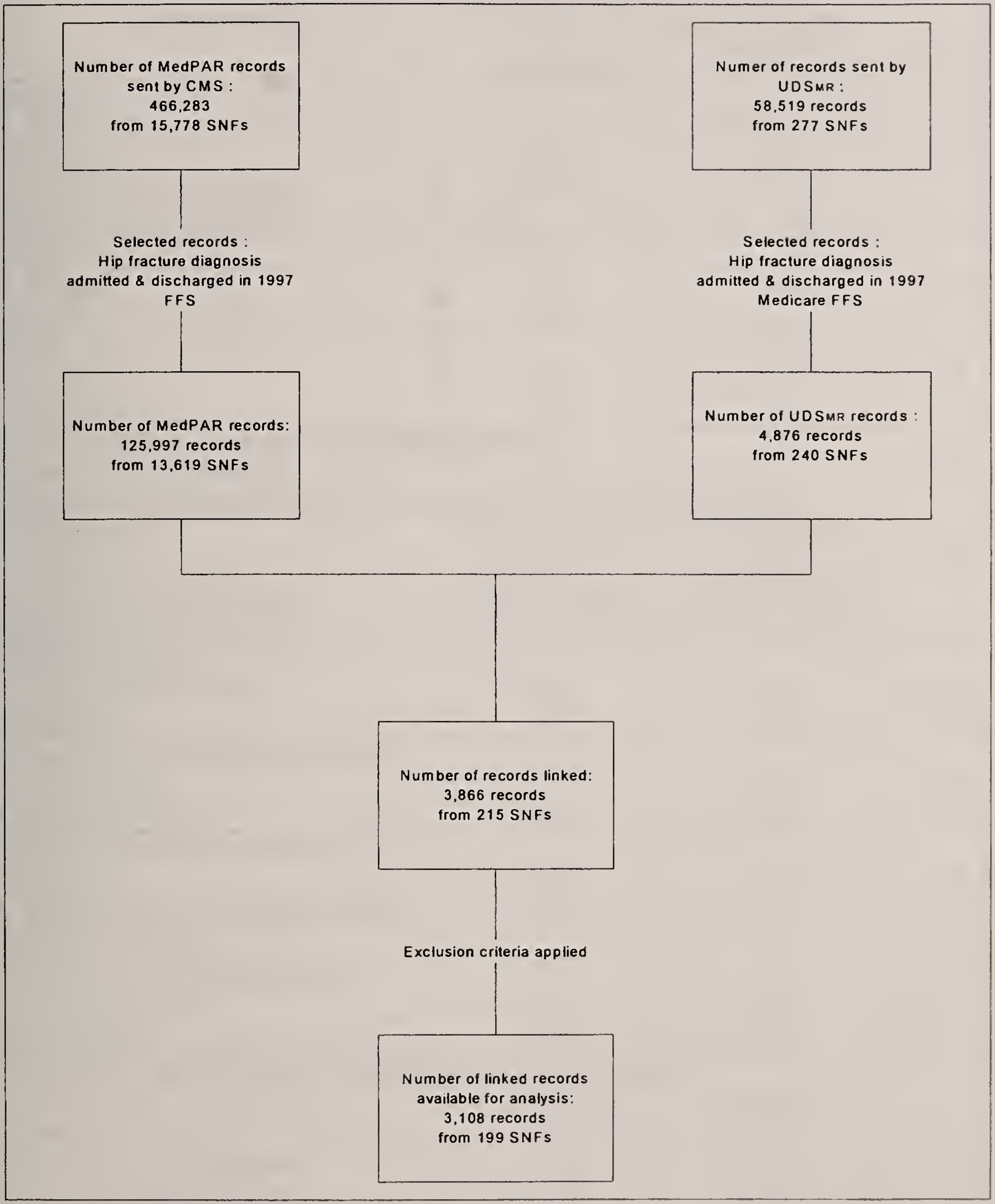
The percent of patients with intracapsular hip fractures was higher in IRFs than in SNFs (38.4% versus 28.9%), and comorbidities/complications were more prevalent among patients in the IRFs than in SNFs (13.9% versus 8.8%), respectively.

Figure 4.3 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Inpatient Rehabilitation Facilities, 1997 Hip Fracture


Number of MedPAR records sent by CMS : 1,460,199 Number of IRF records: 121,806 records from 1,143 IRFs
Numer of records sent by UDSMR : 294,907 records from 655 IRFs
Selected records : Hip fracture diagnosis admitted & discharged in 1997 FFS
Selected records : Hip fracture diagnosis admitted & discharged in 1997 Medicare FFS
Number of MedPAR records: 27,962 records from 954 facilities
Number of UDSMR records : 21,858 records from 611 IRFs
Number of records linked: 14,576 records from 502 facilities
Exclusion criteria applied
Number of linked records available for analysis: 12,228 records from 489 facilities

MedPAR refers to Medicare Payment and Review Record, CMS, Centers for Medicare and Medicaid Services; UDSMR, Uniform Data System for Medical Rehabilitation; IRF, Inpatient Rehabilitation Facility; FFS, fee-for-service

Figure 4.4 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Skilled Nursing Facilities, 1997 Hip Fracture


Number of MedPAR records sent by CMS : 466,283 from 15,778 SNFs
Numer of records sent by UDSMR : 58,519 records from 277 SNFs
Selected records : Hip fracture diagnosis admitted & discharged in 1997 FFS
Selected records : Hip fracture diagnosis admitted & discharged in 1997 Medicare FFS
Number of MedPAR records: 125,997 records from 13,619 SNFs
Number of UDSMR records : 4,876 records from 240 SNFs
Number of records linked: 3,866 records from 215 SNFs
Exclusion criteria applied
Number of linked records available for analysis: 3,108 records from 199 SNFs

MedPAR refers to Medicare Payment and Review Record, CMS, Centers for Medicare and Medicaid Services; UDSMR, Uniform Data System for Medical Rehabilitation; SNF, Skilled Nursing Facility; FFS, fee-for-service

Table 4.20 Sociodemographic and Hospitalization Characteristics of Patients with Hip Fracture by Rehabilitation Setting, 1997 (n = 15,336)

Characteristic	Inpatient Rehabilitation Facility (n=12,228)	Skilled Nursing Facility (n=3,108)	P
Age (yr)			< .001
Mean (SD)	80.5 (8.2)	82.2 (8.1)	
Median	81	83	
25th and 75th percentiles	76 – 86	77 – 88	
Minimum and Maximum	25 — 103	24 — 104	
Sex (%)			.005
Female	77.6	79.9	
Male	22.4	20.1	
Race (%)			< .001
White	93.3	96.4	
Non-white	6.7	3.6	
Dually eligible for Medicare and Medicaid (%)			< .001
Medicare and Medicaid	8.6	6.3	
Median household income based on ZIP code (1993 U.S. Dollars)			< .001
Mean (SD)	33,847 (13,057)	37,385 (12,883)	
Median	31,313	35,011	
25th and 75th percentiles	25,056 – 39,904	28,160 – 44,193	
Minimum and maximum	5,591 – 131,581	11,012 –120,369	
Marital status (%)			< .001
Not currently married	66.9	70.8	
Married	33.1	29.2	
Lived alone prior to fracture (%)			.326
Lived alone	42.1	43.1	
Lived with others	57.9	56.9	
Pre-hospital living setting (%)			< .001
Home	95.6	91.9	
Board & Care, Transitional Living	4.4	8.1	
Admit from (%)			.019
Community-based setting	2.0	1.5	
Acute care unit	97.0	97.9	
Unspecified	1.0	0.6	
Time from hip fracture to rehabilitation admission (days)			< .001
Mean (SD)	7.0 (5.7)	7.8 (6.8)	
Median	5	6	
25th and 75th percentiles	4 – 8	4 – 8	
Minimum and maximum	0 — 59	0 — 57	
Length of rehabilitation stay (days)			< .001
Mean (SD)	16.0 (8.0)	23.3 (15.1)	
Median	14	20	
25th and 75th percentiles	10 – 20	13 – 28	
Minimum and maximum	4 — 73	4 — 118	

Table 4.20 (cont'd)

Characteristic	IRF (n=12,228)	SNF (n=3,108)	P
Time from onset to rehabilitation discharge (days)			< .001
Mean (SD)	23.0 (10.5)	31.1 (17.2)	
Median	21	27	
25th and 75th percentiles	16 – 28	19 – 38	
Minimum and maximum	4 — 94	5 — 137	
Discharge setting (%)			.474
Community	80.6	81.1	
Type of hip fracture (%)			< .001
Extracapsular fracture	61.6	71.1	
Intracapsular fracture	38.4	28.9	
Comorbidities/complications (%)			< .001
Tier 1 (most severe)	0.3	0.1	
Tier 2 (moderately severe)	4.2	2.3	
Tier 3 (mild)	9.4	6.4	
None of listed comorbidities	86.1	91.2	
Case-Mix Group distribution (%)			< .001
701 – mild disability	17.9	17.6	
702 – mild to moderate disability	23.7	21.0	
703 – moderate disability	16.2	15.2	
704 – moderate to severe disability	13.6	12.5	
705 – severe disability	28.7	33.7	
Admission motor FIM rating			< .001
Mean (SD)	44.4 (10.4)	42.8 (11.7)	
Median	45	44	
25th and 75th percentiles	38 – 52	35 – 51	
Minimum and maximum	13 – 79	13 — 83	
Admission cognitive FIM rating			.717
Mean (SD)	28.8 (6.7)	28.3 (7.7)	
Median	31	31	
25th and 75th percentiles	25 – 35	24 – 35	
Minimum and maximum	5 — 35	5 — 35	
Discharge motor FIM rating			.022
Mean (SD)	66.2 (13.5)	64.7 (16.0)	
Median	70	69	
25th and 75th percentiles	59 – 76	56 – 77	
Minimum and maximum	13 — 89	13 — 91	
Discharge cognitive FIM rating			.036
Mean (SD)	30.2 (6.0)	29.5 (7.0)	
Median	32	32	
25th and 75th percentiles	28 – 35	27 – 35	
Minimum and maximum	5 — 35	5 — 35	

P refers to probability; yr, year; SD, standard deviation; ZIP, Zone Improvement Plan; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Significance levels determined using Mann-Whitney *U* and Chi-square tests.

Patient Characteristics – 1997 Hip Fracture Database (cont'd)

The distribution of patients by Case-Mix Group was different in IRFs and SNFs, with a slightly higher percentage of patients in Case-Mix Group 702 (mild to moderate disability), Case-Mix Group 703 (moderate disability), and Case-Mix Group (704) (moderate to severe disability) receiving care in an IRF, as shown in Table 4.34. Percentages of patients in Case-Mix Group 701 (mild disability) were similar in the 2 settings, whereas SNFs had a higher percentage of patients in Case-Mix Group 705 (severe disability).

The admission and discharge motor FIM ratings were slightly higher on average for patients in IRFs than for patients in SNFs, indicating patients in SNFs were on average more dependent in self-care, bladder and bowel management, transfer and locomotion skills at the time of admission and discharge.

On the other hand, although cognitive FIM ratings on admission were not different ($p = .717$), the mean cognitive FIM ratings at discharge were slightly lower (i.e., less functional) for patients discharged from SNFs.

Reliability of FIM Ratings – 1997 Hip Fracture Database

Table 4.21 reports the results of reliability analyses separately for IRF patient records and SNF patient records included in the 1997 hip fracture database. All

values were above .80 indicating good reliability.[109] As with the 1996 hip fracture database, SNF values were slightly higher than the IRF values.

Table 4.21 Cronbach's Alpha for FIM Data, Patients with Hip Fracture, 1997 (n = 15,336)

Rating Scale	Inpatient Rehabilitation Facility (n = 12,228)		Skilled Nursing Facility (n = 3,108)	
	Cronbach's Alpha	95% CI	Cronbach's Alpha	95% CI
Admission motor FIM ratings (13 items)	.848	.844 to .852	.872	.865 to .879
Admission cognitive FIM ratings (5 items)	.924	.922 to .926	.947	.944 to .950
Discharge motor FIM ratings (13 items)	.928	.926 to .930	.941	.938 to .944
Discharge cognitive FIM ratings (5 items)	.928	.925 to .930	.951	.948 to .954

FIM refers to Functional Independence Measure; CI, confidence interval

Facility-Level Market Characteristics – 1997 Hip Fracture Database

The 1997 hip fracture database included data from 489 IRFs and 199 SNFs. As reported in Table 4.22, approximately one-quarter of the IRFs were freestanding facilities, whereas greater than 70 percent of SNFs were freestanding facilities.

The most frequent geographic locations for IRFs were the East North Central region (23.3% of facilities), followed by the South Atlantic region (18.4%), and the West South Central region (17.8%). SNFs were most commonly located in the East North Central region (23.1%), the Middle Atlantic region (18.6%), and the South Atlantic region (14.6%).

Table 4.22 Characteristics of Facilities by Rehabilitation Setting, Patients with Hip Fracture, 1997 (n = 688 Facilities)

Characteristic	Inpatient Rehabilitation Facility (n=489)	Skilled Nursing Facility (n=199)	P
Type of facility (%)			< .001
Freestanding	25.4	70.9	
Distinct unit	74.6	29.1	
Rural status (%)			.222
Rural	9.4	6.5	
Geographic location* (%)			< .001
New England	3.5	12.6	
Middle Atlantic	11.0	18.6	
East North Central	23.3	23.1	
West North Central	6.7	6.5	
South Atlantic	18.4	14.6	
East South Central	4.9	0.5	
West South Central	17.8	5.5	
Mountain	5.5	7.5	
Pacific	8.8	11.1	
Volume: number of patients (all payers)			< .001
Mean (SD)	54.7 (51.6)	34.8 (35.8)	
Median	40	24	
25th and 75th percentiles	19 – 73	11 – 48	
Minimum and maximum	1 — 389	1 — 267	
Managed care penetration in county (%)			< .001
Mean (SD)	27.2 (17.1)	33.8 (15.4)	
Median	26.3	31.9	
25th and 75th percentiles	14.2 – 40.7	24.5 – 44.0	
Minimum and Maximum	0 — 80.0	0 — 74.5	
Patients in facility with managed care insurance (%)			.034
Mean (SD)	7.2 (9.4)	13.1 (18.5)	
Median	3.4	4.9	
25th and 75th percentiles	0.4 – 11.4	0 – 17.8	
Minimum and Maximum	0 — 86.0	0 — 90.0	
JCAHO accreditation (self-reported, %)			< .001
Yes	90.8	5.0	
No	9.2	95.0	
CARF accreditation (self-reported, %)			< .001
Yes	72.6	17.6	
No	27.4	82.4	
Number of operating beds			.009
Mean (SD)	34.3 (26.1)	28.3 (19.4)	
Median	25	24	
25th and 75th percentiles	18 – 43	16 – 34	
Minimum and Maximum	5 — 270	2 — 163	

Table 4.22 (cont'd)

Characteristic	Inpatient Rehabilitation Facility (n=489)	Skilled Nursing Facility (n=199)	P
Facility ownership (%)			< .001
Government (Federal, state, county, local)	6.9	2.5	
Non-government, non-church-affiliated, not-for-profit	42.3	26.6	
Church-affiliated, non-government, not-for-profit	23.3	16.1	
Church-affiliated, for profit	0.8	0.0	
For profit, non-church-affiliated	18.6	50.8	
Other, unspecified	7.9	4.0	
Number of records in analysis			< .001
Mean (SD)	25.0 (29.3)	15.6 (20.5)	
Median	15	9	
25th and 75th percentiles	5 – 34	3 – 21	
Minimum and Maximum	1 — 191	1 — 168	

P refers to probability; SD, standard deviation; JCAHO, Joint Commission on Accreditation of Healthcare Organizations; CARF, Commission on Accreditation of Rehabilitation Facilities; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Significance levels determined using Mann-Whitney *U* (continuous variables) and Chi-square (categorical) tests.

* See Appendix A: Glossary of Terms for a list of the States included in each geographic region.

Facility-Level Market Characteristics – 1997 Hip Fracture Database (cont'd)

In 1997, each IRF in the study treated a median of 40 patients with hip fracture (all payers), while the SNFs treated a median of 24 patients per facility. Managed care penetration was slightly lower in the counties where IRFs were located. The median percent of patients with managed care health insurance in the IRFs was 3.4 and in the SNFs was 4.9.

More than 90 percent of IRFs, and 5.0 percent of SNFs were accredited by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO).

Approximately 73 percent of IRFs, and 18 percent of SNFs were accredited by the Commission on Accreditation of Rehabilitation Facilities (CARF).

IRFs had a higher number of operating beds in the facility, with half of the IRFs reporting between 18 to 43 beds (25th to 75th percentile), and SNFs reporting 16 to 34 beds. Approximately 66 percent of the IRFs were not-for-profit (both church-affiliated and non-church-affiliated) entities, whereas 51 percent of SNFs were for-profit entities.

The median number of records from each facility used in the analysis was 15 for IRFs, and 9 for SNFs.

Research Question 1: Did the Percentage of Patients with Hip Fracture Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1997?

Preparing Data for Logistic Regression Analyses

Logistic regression was used to determine whether the percent of patients with hip fracture discharged to the community was different for IRFs and SNFs in 1997.

The analysis began with the examination of the distribution of each continuous covariate. If indicated, data were transformed based on the procedure (e.g.,

logarithm, square root) which best provided a normal distribution as evidenced by the lowest Kolmogorov-Smirnov statistic.

Correlations between each of the transformed covariates and the independent variable were reviewed to assess for the potential of multicollinearity. All Pearson correlations were below the absolute value of 0.5. The strongest correlation 0.484, between the transformed values of admission motor FIM rating and admission cognitive FIM rating.

The first series of logistic regression analyses tested for statistical interaction effects using all records in the 1997 hip fracture database. There were no significant interactions detected between 1) admission motor FIM ratings and the rehabilitation setting (p = .800); or 2) living alone prior to condition onset and rehabilitation setting (p = .435).

The cross-product term of age and rehabilitation setting was significant (p = .038), and the 3-way interaction term of admission motor FIM rating, age and the rehabilitation setting had a significance level of < .001, indicating an effect-measure modification based on age, admission motor FIM ratings and rehabilitation setting.

Based on these results, the 1997 hip fracture database was stratified into 4 approximately equal groups using the same age and case-mix groupings used in the 1996 hip fracture regression analyses. The groups were: 1) the records of

patients with mild to moderate disability (Case-Mix Group 701, 702 and 703) who were 82 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Group 701, 702 and 703) who were 83 years of age or older, 3) the records of patients with severe disability (Case-Mix Group 704 and 705) who were 82 years of age or younger, 4) the records of patients with severe disability (Case-Mix Group 704 and 705) who were 83 years of age or older.

Once data were stratified into the 4 case-mix/age groups, the distributions of each continuous covariate were examined, and, if appropriate, data were transformed as needed to meet statistical model requirements.

Correlations between each of the transformed covariates and the independent variable were reviewed to assess for the potential of multicollinearity. All correlations were below the absolute value of 0.5. The strongest correlation for Group 1 was 0.273 (between the transformed values of median household income and managed care penetration), 0.265 (between the transformed values of median household income and managed care penetration) for Group 2, 0.404 (between the transformed values of the admission motor FIM ratings and the admission cognitive FIM ratings) for Group 3, and 0.429 (between the transformed values of the admission motor FIM ratings and the admission cognitive FIM ratings) for Group 4.

The Percent of Patients Discharged to the Community from Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The unadjusted (i.e., no adjustment for covariates) percentages of patients discharged to the community for IRFs and SNFs were calculated, and are reported in Table 4.23.

The percent of patients discharged to community-based settings from IRFs and SNFs among young patients (Group 1 and Group 3) was not different. For older patients with mild to moderate disabilities (Group 2), the percent of patients discharged to the community was slightly higher (83.8% for IRFs versus 86.6% for SNFs; p = .056). Among older patients with severe disabilities (Group 4), a higher percentage of patients who received care in SNFs (62.9% for IRFs and 68.1% for SNFs; p = .009) were discharged to the community.

Table 4.23 Unadjusted Percent of Patients with Hip Fracture Discharged to Community-Based Settings by Rehabilitation Setting, 1997 (n = 15,336)

Group		Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	**Mild to Moderate Disability & age ≤ 82 years**	93.8% (n= 4,388)	92.7% (n = 889)	.224
2	**Mild to Moderate Disability & age ≥ 83 years**	83.8% (n = 2,669)	86.6% (n = 783)	.056
3	**Severe Disability & age ≤ 82 years**	74.8% (n = 2,514)	74.1% (n = 576)	.732
4	**Severe Disability & age ≥ 83 years**	62.9% (n = 2,657)	68.1% (n = 860)	.009

P refers to probability
Significance levels determined using Mann-Whitney *U* procedure.

Logistic Regression Results for the 1997 Hip Fracture Database

Results of the logistic regression analyses for the 4 groups are reported in Tables 4.24, 4.25, 4.26 and 4.27. As with the other analyses, coefficients for covariates are reported in these tables, but are not discussed; coefficients for some of these variables may be unstable.[112] Results for covariates using untransformed data are reported and discussed in Appendix F (Tables F.5 to F.8).

For young patients (Group 1 and Group 3; Table 4.24 and Table 4.26), after controlling for covariates, the percent of patients discharged to the community from the two settings was not statistically different (p = .490 and p = .246, respectively).

Among older patients with mild to moderate disabilities (Group 3; Table 4.28), the rehabilitation setting variable showed borderline significance (p = .073). Patients treated in IRFs were perhaps slightly less likely to return to the community with an adjusted odds ratio of 0.80 (95% CI: 0.62 to 1.02).

For older patients with severe disabilities (Group 4; Table 4.27), the percent of patients discharged to community-based settings for the 2 groups was statistically different (p < .001) after adjusting for covariates. Patients in IRFs were less likely to return to the community with an adjusted odds ratio of 0.69 (95% CI: 0.57 to 0.83).

Table 4.24 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disabilities (Case-Mix Groups 701, 702 and 703) and 82 Years Old or Younger, 1997 Hip Fracture Database (n = 5,277)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time (*logarithm base 10*)	-0.269	0.194	1.93	0.165	0.76	0.52	1.12
Admission motor FIM rating (*natural logarithm*)	3.521	0.580	36.91	< .001	33.82	10.86	105.32
Admission cognitive FIM rating (*square*)	0.002	0.000	65.07	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.319	0.113	7.92	0.005	0.73	0.58	0.91
Tier 1 comorbidity (present =1)	-0.739	0.808	0.84	0.361	0.48	0.10	2.33
Tier 2 comorbidity (present =1)	-0.790	0.260	9.21	0.002	0.45	0.27	0.76
Tier 3 comorbidity (present =1)	-0.350	0.184	3.62	0.057	0.70	0.49	1.01
Age (*cube*)	0.000	0.000	8.43	0.004	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-0.731	0.114	41.49	< .001	0.48	0.39	0.60
Median household income (*logarithm base 10*)	0.087	0.370	0.05	0.815	1.09	0.53	2.25
Sex (female =1)	-0.053	0.139	0.15	0.701	0.95	0.72	1.25
Race (white =1)	-0.446	0.216	4.27	0.039	0.64	0.42	0.98
Volume of patients (*logarithm base 10*)	0.032	0.171	0.03	0.853	1.03	0.74	1.44
County managed care penetration (*no transformation*)	0.268	0.360	0.55	0.458	1.31	0.64	2.65
Rehabilitation setting (IRF=1, SNF=0)	-0.111	0.161	0.48	0.490	0.90	0.65	1.23
Constant	-11.52	2.759	17.43	< .001	0.00	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.25 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disabilities (Case-Mix Groups 701, 702 and 703) and 83 Years Old or Older, 1997 Hip Fracture Database (n = 3,452)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	-0.086	0.164	0.28	0.600	0.92	0.67	1.27
Admission motor FIM rating (*logarithm base 10*)	7.662	1.214	39.84	< .001	2126.5	196.93	22961
Admission cognitive FIM rating (*square*)	0.001	0.000	34.06	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.269	0.099	7.35	0.007	0.76	0.63	0.93
Tier 1 comorbidity (present =1)	3.316	5.280	0.39	0.530	27.54	0.00	858889
Tier 2 comorbidity (present =1)	-0.500	0.251	3.97	0.046	0.61	0.37	0.99
Tier 3 comorbidity (present =1)	-0.007	0.218	0.00	0.975	0.99	0.65	1.52
Age (*logarithm base 10*)	-7.716	2.728	8.00	0.005	0.00	0.00	0.09
Pre-hospital living alone (alone =1)	-0.582	0.102	32.38	< .001	0.56	0.46	0.68
Median household income (*logarithm base 10*)	0.026	0.337	0.01	0.938	1.03	0.53	1.99
Sex (female =1)	-0.176	0.146	1.46	0.227	0.84	0.63	1.12
Race (white =1)	0.440	0.281	2.45	0.117	1.55	0.90	2.70
Volume of patients (*logarithm base 10*)	0.181	0.154	1.39	0.239	1.20	0.89	1.62
County managed care penetration (*no transformation*)	-0.006	0.308	0.00	0.985	0.99	0.54	1.82
Rehabilitation setting (IRF=1, SNF=0)	-0.226	0.126	3.22	0.073	0.80	0.62	1.02
Constant	3.102	5.973	0.27	0.604	22.24	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.26 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disabilities (Case-Mix Groups 704 and 705) and 82 Years Old or Younger, 1997 Hip Fracture Database (n = 3,090)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time (*logarithm base 10*)	0.162	0.145	1.25	0.264	1.18	0.89	1.56
Admission motor FIM rating (*square*)	0.001	0.000	66.39	< .001	1.00	1.00	1.00
Admission cognitive FIM rating (*square*)	0.001	0.000	49.72	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.229	0.089	6.62	0.010	0.80	0.67	0.95
Tier 1 comorbidity (present =1)	0.314	0.605	0.27	0.604	1.37	0.42	4.48
Tier 2 comorbidity (present =1)	-0.054	0.177	0.09	0.761	0.95	0.67	1.34
Tier 3 comorbidity (present =1)	0.109	0.127	0.73	0.392	1.11	0.87	1.43
Age (*cube*)	0.000	0.000	7.29	0.007	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-0.646	0.094	46.97	< .001	0.52	0.44	0.63
Median household income (*logarithm base 10*)	0.003	0.291	0.00	0.993	1.00	0.57	1.78
Sex (female =1)	0.058	0.099	0.35	0.556	1.06	0.87	1.29
Race (white =1)	-0.050	0.158	0.10	0.752	0.95	0.70	1.30
Volume of patients (*logarithm base 10*)	0.214	0.119	3.21	0.073	1.24	0.98	1.56
County managed care penetration (*no transformation*)	-0.059	0.270	0.05	0.828	0.94	0.56	1.60
Rehabilitation setting (IRF=1, SNF=0)	-0.137	0.118	1.35	0.246	0.87	0.69	1.10
Constant	-0.187	1.358	0.02	0.890	0.83	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.27 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disabilities (Case-Mix Groups 704 and 705) and 83 Years or Older, 1997 Hip Fracture Database (n =3,517)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	0.023	0.122	0.04	0.848	1.02	0.81	1.30
Admission motor FIM rating (*square*)	0.001	0.000	96.23	< .001	1.00	1.00	1.00
Admission cognitive FIM rating (*square*)	0.001	0.000	27.15	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.258	0.075	11.94	0.001	0.77	0.67	0.89
Tier 1 comorbidity (present =1)	0.208	0.736	0.08	0.777	1.23	0.29	5.21
Tier 2 comorbidity (present =1)	-0.317	0.164	3.76	0.053	0.73	0.53	1.00
Tier 3 comorbidity (present =1)	-0.009	0.134	0.00	0.945	0.99	0.76	1.29
Age (*logarithm base 10*)	-5.108	1.937	6.95	0.008	0.01	0.00	0.27
Pre-hospital living alone (alone =1)	-0.523	0.077	45.55	< .001	0.59	0.51	0.69
Median household income (*logarithm base 10*)	0.081	0.249	0.11	0.744	1.08	0.67	1.77
Sex (female =1)	-0.144	0.094	2.32	0.128	0.87	0.72	1.04
Race (white =1)	0.491	0.157	9.75	0.002	1.63	1.20	2.22
Volume of patients (*logarithm base 10*)	0.014	0.109	0.02	0.899	1.01	0.82	1.26
County managed care penetration (*no transformation*)	-0.275	0.228	1.46	0.227	0.76	0.49	1.19
Rehabilitation setting (IRF=1, SNF=0)	-0.377	0.095	15.70	< .001	0.69	0.57	0.83
Constant	9.464	3.986	5.64	0.018	12881	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Post-Hoc Power Analyses for Logistic Regression Results – 1997 Hip Fracture Database

The estimated power of analyses was calculated post-hoc to assist with interpretation of the results. As shown in Table 4.28, the estimated power for the logistic regression analyses with an alpha of 0.05 and a 5 percent difference in rates considered clinically important, was 99 percent for Groups 1 and 2, 91 percent for the third group, and 93 percent for the fourth group.

Table 4.28 Post-Hoc Power Estimates for Logistic Regression Analyses, 1997 Hip Fracture Database (n = 15,336)

Group		IRF n	SNF n	Community Discharge – Percent		Alpha	Estimated power
				low	high		
1	Mild to Moderate Disability & age ≤ 82 years	4,388	889	90	95	.05	.99
2	Mild to Moderate Disability & age ≥ 83 years	2,669	783	83	88	.05	.99
3	Severe Disability & age ≤ 82 years	2,514	576	73	78	.05	.91
4	Severe Disability & age ≥ 83 years	2,657	860	63	68	.05	.93

IRF refers to Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Assessment for Bias in Logistic Regression Results Due to Methodology – 1997 Hip Fracture Database

In the 1997 hip fracture database, the median percent of records linked was 81.8 for IRFs and 84.2 for SNFs. To determine whether the study methodology, including the procedures used to link the data, resulted in biased regression

estimates, analyses of the UDSMR data for all Medicare fee-for-service patients with hip fracture were conducted. Results using the UDSMR data and results using the linked UDSMR/MedPAR data were compared to determine whether the linked data may have produced biased coefficients. The regression estimates, reported in Appendix G (Table G.3), did not appear to show any obvious bias. The odds ratios estimated for each of the 4 groups using the linked data were all within ± 15 percent of the odds ratios estimated for the corresponding group using the UDSMR data.

As previously noted, the logistic regression analyses included only the records of patients who had typical stays. In the 1997 hip fracture database, 16.1 percent of IRF records and 19.6 percent of SNF records were excluded from analyses because they were considered "atypical" stays, or FIM data were missing. To determine whether an alternative set of exclusion criteria would have led to different results, additional analyses of the UDSMR/MedPAR linked data were conducted with 2 alternative exclusion criteria. Results of the study using the Original Study Exclusion Criteria (i.e., excluding "atypical" stays), and results using the 2 alternative exclusion criteria were compared.

The first set of alternative exclusion criteria, referred to as Exclusion Criteria A, was the same as the Original Study Exclusion Criteria, except that it included the records of patients who had program interruptions, patients who died and patients who were discharged to acute care hospitals. For the Exclusion Criteria

A analyses, patients who died were considered to have had a non-community discharge.

The second set of alternative exclusion criteria, called Exclusion Criteria B, was the same as the Original Study Exclusion Criteria, with the additional exclusion of patients who were younger than 65. Individuals younger than 65 who were Medicare beneficiaries had either a long-term (greater than 2 years) disability or had renal failure.

Results of the logistic regression analyses using the Original Study Exclusion Criteria (reported in Tables 4.24, 4.25, 4.26 and 4.27) and results using Exclusion Criteria A and Exclusion Criteria B are reported in Appendix H (Table H.3).

A comparison of results using Exclusion Criteria A and results using the Original Study Exclusion Criteria showed that the odds ratios for corresponding groups were similar (i.e., within ± 15%) for each of the 4 groups. The odds ratios for corresponding groups were also similar (i.e., within ± 15%) when Exclusion Criteria B and the Study Exclusion Criteria were applied.

Summary of Logistic Regression Analyses of the 1997 Hip Fracture Database

Overall, the analyses of 1997 hip fracture database showed that the percent of patients with hip fractures discharged to community-based settings was higher for SNFs for patients who were 83 years of age and older. For younger patients, there were no differences in the percent of patients discharged to the community.

Research Question 2: Did the Functional Outcomes of Patients with Hip Fracture Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1997?

Preparing Data for the Multiple Linear Regression Analyses

The hypothesis that discharge motor function status of patients with hip fractures differed when patients received treatment in an IRF versus a SNF was tested using multiple linear regression. The 14 covariates were entered into the model first to adjust for any differences in patient or market (facility-level) factors, followed by the rehabilitation setting variable.

The distribution of the discharge motor FIM ratings was only slightly negatively skewed, but not enough to warrant transformation. As described previously, some of the continuous covariates were transformed, and correlations between each of the covariates and the independent variable were all weaker than 0.5.

Analyses began with running ANCOVA to assess for the presence of effect-measure modification. Eta^2 was calculated to estimate the importance of any interactions.

Statistically significant interactions were found between: 1) admission motor FIM rating and the rehabilitation setting ($p < .001$; $\text{eta}^2 = .001$), 2) age and rehabilitation setting ($p = .008$; $\text{eta}^2 < .001$), and 3) admission motor FIM rating, age and the rehabilitation setting ($p < .001$; $\text{eta}^2 = .010$).

The cross-product term of living alone prior to hip fracture and rehabilitation setting was not significant ($p = .092$).

Based on these results, the 1997 hip fracture database was stratified into 4 groups based on Case-Mix Group assignment and the median age of 82. The groups, the same ones used for the logistic regression analyses, were: 1) the records of patients with mild to moderate disability (Case-Mix Groups 701, 702 and 703) who were 82 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 701, 702 and 703) who were 83 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 704 and 705) who were 82 years of age or younger, 4) the records of patients with severe disability (Case-Mix Groups 704 and 705) who were 83 years of age or older.

The distribution of continuous variables for each group was examined, and, if indicated, the continuous covariates were transformed. Pearson correlations between the covariates and the independent variable were all weaker than 0.5. The distributions of the dependent variable, the discharge motor FIM ratings, were only slightly skewed, and these data were not transformed.

Discharge Motor FIM Ratings of Patients Treated in Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The unadjusted mean, standard deviation and median discharge motor FIM ratings for each of the 4 groups are reported in Table 4.29.

Table 4.29 Unadjusted Mean, Standard Deviation, and Median Discharge Motor FIM Ratings of Patients with Hip Fractures by Group, 1997 (n = 15,336)

Group		Description	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	**Mild to moderate disability & 82 years of age or younger**	Number	4,388	889	.105
		Mean (SD)	73.7 (7.6)	73.9 (8.5)	
		Median	75	76	
2	**Mild to moderate disability & 83 years of age or older**	Number	2,669	783	.011
		Mean (SD)	71.2 (8.3)	71.7 (9.3)	
		Median	72	74	
3	**Severe disability & 82 years of age or younger**	Number	2,514	576	.003
		Mean (SD)	59.0 (14.4)	56.3 (16.9)	
		Median	61	59	
4	**Severe disability & 83 years of age or older**	Number	2,657	860	.276
		Mean (SD)	55.6 (14.3)	54.4 (17.1)	
		Median	57	56	

FIM refers to Functional Independence Measure; P, probability; SD, standard deviation.
Significance determined using Mann-Whitney U procedure.

These data show that motor FIM ratings were significantly different for 2 of the 4 groups. The median of the SNF ratings was higher (74) than that of the IRFs (72) for Group 2, which included persons who were mild to moderately disabled and older, and the IRF median was higher by a difference of 2 FIM units (61 for IRFs versus 59 for SNFs) for Group 3.

Multiple Linear Regression Results for the 1997 Hip Fracture Database

Results of the multiple linear regression analyses for the 4 case-mix/age groups are reported in tables 4.30, 4.31, 4.32 and 4.33.

As with the other regression analyses, coefficients for covariates are reported in these tables, but are not discussed since some of these coefficients may be unstable.[112] The results for covariates using untransformed data are reported and discussed in Appendix F (Tables F.13 to F.16).

The type of rehabilitation setting (i.e., IRF or SNF) did not demonstrate a statistically significant effect ($p = .893$, $p = .583$, $p = .158$, $p = .141$, respectively) for patients in any of the 4 groups.

Multicollinearity was not a concern for any of the multiple regression models used; the highest variance inflation factor values within each model were 1.142 for Group 1, 1.145 for Group 2, 1.247 for Group 3 and 1.237 for Group 4. These values are well below the value of 4, which could indicate a potential problem.[113]

Table 4.30 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger, 1997 Hip Fracture Database (n = 5,277)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	-30.47	4.36	--	-6.99	< .001	-39.02	-21.93
Onset time (*logarithm base 10*)	-1.73	0.34	-0.06	-5.12	< .001	-2.39	-1.07
Admission motor FIM rating (*natural logarithm*)	23.71	0.87	0.34	27.17	< .001	22.00	25.42
Admission cognitive FIM rating (*square*)	0.01	0.00	0.23	18.45	< .001	0.01	0.01
Type of hip fracture (Extracapsular fracture = 1)	-0.62	0.20	-0.04	-3.07	0.002	-1.01	-0.22
Tier 1 comorbidity (present =1)	-2.62	1.97	-0.02	-1.33	0.183	-6.47	1.24
Tier 2 comorbidity (present =1)	-0.71	0.60	-0.01	-1.17	0.241	-1.89	0.47
Tier 3 comorbidity (present =1)	-1.69	0.35	-0.06	-4.80	< .001	-2.37	-1.00
Age (*cube*)	0.00	0.00	-0.02	-1.42	0.156	0.00	0.00
Pre-hospital living alone (alone =1)	1.37	0.19	0.09	7.02	< .001	0.99	1.75
Median household income (*logarithm base 10*)	0.81	0.64	0.02	1.28	0.201	-0.43	2.06
Sex (female = 1)	0.08	0.23	0.00	0.34	0.736	-0.37	0.53
Race (white = 1)	-0.57	0.42	-0.02	-1.36	0.174	-1.39	0.25
Volume of patients (*logarithm base 10*)	0.60	0.29	0.03	2.07	0.038	0.03	1.18
County managed care penetration (*no transformation*)	1.16	0.62	0.02	1.88	0.061	-0.05	2.37
Rehabilitation setting (IRF = 1, SNF = 0)	0.04	0.26	0.00	0.14	0.893	-0.47	0.54

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.31 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older, 1997 Hip Fracture Database (n = 3,452)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	49.17	16.04	--	3.06	0.002	17.71	80.62
Onset time (*logarithm base 10*)	-1.51	0.43	-0.05	-3.53	< .001	-2.35	-0.67
Admission motor FIM rating (*logarithm base 10*)	62.95	2.86	0.34	22.00	< .001	57.34	68.56
Admission cognitive FIM rating (*square*)	0.01	0.00	0.23	15.27	< .001	0.01	0.01
Type of hip fracture (Extracapsular fracture = 1)	-0.95	0.27	-0.05	-3.55	< .001	-1.48	-0.43
Tier 1 comorbidity (present =1)	-1.56	3.05	-0.01	-0.51	0.609	-7.53	4.42
Tier 2 comorbidity (present =1)	-0.67	0.76	-0.01	-0.88	0.379	-2.17	0.83
Tier 3 comorbidity (present =1)	-1.22	0.58	-0.03	-2.11	0.035	-2.36	-0.08
Age (*logarithm base 10*)	-52.46	7.45	-0.11	-7.04	< .001	-67.06	-37.86
Pre-hospital living alone (alone =1)	1.00	0.26	0.06	3.82	< .001	0.49	1.51
Median household income (*logarithm base 10*)	2.30	0.87	0.04	2.63	0.009	0.59	4.01
Sex (female = 1)	-0.25	0.36	-0.01	-0.69	0.491	-0.94	0.45
Race (white = 1)	-0.94	0.67	-0.02	-1.40	0.160	-2.25	0.37
Volume of patients (*logarithm base 10*)	0.21	0.40	0.01	0.52	0.601	-0.58	1.00
County managed care penetration (*no transformation*)	0.71	0.82	0.01	0.86	0.388	-0.90	2.31
Rehabilitation setting (IRF = 1, SNF = 0)	-0.17	0.32	-0.01	-0.55	0.583	-0.80	0.45

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.32 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger, 1997 Hip Fracture Database (n = 3,090)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	13.44	6.35	--	2.12	0.034	0.98	25.90
Onset time (*logarithm base 10*)	-1.68	0.69	-0.03	-2.44	0.015	-3.02	-0.33
Admission motor FIM rating (*square*)	0.02	0.00	0.47	31.14	< .001	0.01	0.02
Admission cognitive FIM rating (*square*)	0.01	0.00	0.27	18.02	< .001	0.01	0.01
Type of hip fracture (Extracapsular fracture = 1)	-0.73	0.42	-0.02	-1.75	0.081	-1.55	0.09
Tier 1 comorbidity (present =1)	-1.38	2.66	-0.01	-0.52	0.604	-6.59	3.83
Tier 2 comorbidity (present =1)	-1.54	0.88	-0.02	-1.76	0.079	-3.26	0.18
Tier 3 comorbidity (present =1)	-1.42	0.59	-0.03	-2.41	0.016	-2.57	-0.27
Age (*cube*)	0.00	0.00	-0.01	-0.79	0.428	0.00	0.00
Pre-hospital living alone (alone =1)	2.27	0.45	0.07	5.06	< .001	1.39	3.14
Median household income (*logarithm base 10*)	3.55	1.36	0.04	2.61	0.009	0.88	6.22
Sex (female = 1)	0.05	0.46	0.00	0.10	0.921	-0.86	0.95
Race (white = 1)	-1.07	0.74	-0.02	-1.45	0.148	-2.52	0.38
Volume of patients (*logarithm base 10*)	1.35	0.57	0.03	2.38	0.018	0.24	2.46
County managed care penetration (*no transformation*)	-0.94	1.27	-0.01	-0.74	0.457	-3.43	1.54
Rehabilitation setting (IRF =1, SNF = 0)	0.77	0.55	0.02	1.41	0.158	-0.30	1.84

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.33 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older, 1997 Hip Fracture Database (n = 3,517)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	127.69	20.41	--	6.26	< .001	87.67	167.70
Onset time (*logarithm base 10*)	-1.36	0.63	-0.03	-2.18	0.030	-2.59	-0.13
Admission motor FIM rating (*square*)	0.02	0.00	0.51	36.83	< .001	0.02	0.02
Admission cognitive FIM rating (*square*)	0.00	0.00	0.25	17.95	< .001	0.00	0.00
Type of hip fracture (Extracapsular fracture = 1)	-1.16	0.38	-0.04	-3.05	0.002	-1.91	-0.42
Tier 1 comorbidity (present =1)	-1.69	3.69	-0.01	-0.46	0.647	-8.94	5.55
Tier 2 comorbidity (present =1)	-1.57	0.86	-0.02	-1.83	0.068	-3.26	0.12
Tier 3 comorbidity (present =1)	-1.06	0.68	-0.02	-1.56	0.119	-2.39	0.27
Age (*logarithm base 10*)	-60.12	9.93	-0.08	-6.05	< .001	-79.60	-40.65
Pre-hospital living alone (alone =1)	2.08	0.39	0.07	5.31	< .001	1.31	2.85
Median household income (*logarithm base 10*)	4.74	1.27	0.05	3.74	< .001	2.26	7.22
Sex (female = 1)	-0.58	0.47	-0.02	-1.23	0.219	-1.51	0.35
Race (white = 1)	-0.62	0.76	-0.01	-0.81	0.416	-2.12	0.88
Volume of patients (*logarithm base 10*)	-0.08	0.55	0.00	-0.15	0.884	-1.16	1.00
County managed care penetration (*no transformation*)	-1.08	1.17	-0.01	-0.93	0.353	-3.37	1.20
Rehabilitation setting (IRF = 1, SNF = 0)	-0.70	0.47	-0.02	-1.47	0.141	-1.63	0.23

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Histograms of the standardized regression residuals for each model showed residuals were generally normally distributed, thus addressing the regression assumption of normality.

Post-Hoc Power Analyses for Multiple Linear Regression Results – 1997 Hip Fracture Database

The estimated power of the linear regression analyses was calculated post-hoc to assist with interpretation of the results. As shown in Table 4.34, the estimated power for these analyses with an alpha of 0.05 and small effect size (i.e., incremental R^2 of .005), were 99 percent for each group.

Table 4.34 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1997 Hip Fracture Database (n = 15,336)

Group		Number of Patient Records	Adjusted R^2	Effect Size: Incremental R^2 Increase	Alpha	Estimated Power
1	**Mild to Moderate Disability & age ≤ 82 years**	5,277	.238	.005	.05	.99
2	**Mild to Moderate Disability & age ≥ 83 years**	3,452	.242	.005	.05	.99
3	**Severe Disability & age ≤ 82 years**	3,090	.435	.005	.05	.99
4	**Severe Disability & age ≥ 83 years**	3,517	.460	.005	.05	.99

R^2 refers to multiple coefficient of determination

Assessment of Bias in Multiple Linear Regression Results Due to Methodology – 1997 Hip Fracture Database

As reported in the methods section, a median of 81.8 percent of IRF records and 84.2 percent of SNF records were linked with MedPAR data to create the 1997 hip fracture database. To determine whether the study methodology, including the procedures used to link the data, resulted in biased regression estimates, analyses of the UDSMR data for all Medicare fee-for-service patients with hip fracture were conducted. Results from the UDSMR analyses and results from the linked UDSMR/MedPAR analyses were compared to determine whether the linked data may have resulted in biased regression estimates. The regression estimates, reported in Appendix G (Tables Table G.4), did not appear to show any obvious bias. For each of the 4 groups, the estimated odds ratios based on the linked data were within ± 15 percent of the odds ratio of the corresponding group using the UDSMR data.

In the 1997 hip fracture database, 16.1 percent of IRF records and 19.6 percent of SNF records were excluded from analyses because they were considered "atypical" stays, or FIM data were missing. To determine whether an alternative set of exclusion criteria would have led to different results, additional analyses of the UDSMR/MedPAR linked data were executed with 2 alternative exclusion criteria. Results of the study using the Original Study Exclusion Criteria (i.e.,

excluding “atypical” stays), and results using the 2 alternative exclusion criteria were compared.

The first set of alternative exclusion criteria, referred to as Exclusion Criteria A, was the same as the Original Study Exclusion Criteria, except that it included the records of patients who had program interruptions, patients who died and patients who were discharged to acute care hospitals. For the Exclusion Criteria A analysis, the discharge motor FIM ratings for patients who died were recoded as 13 (i.e., dependent in all motor activities).

The second set of alternative exclusion criteria, called Exclusion Criteria B, was the same as the Original Study Exclusion Criteria, with the additional exclusion of patients who were younger than 65. Individuals younger than 65 who are Medicare beneficiaries have a long-term disability or have renal failure.

Results of the multiple linear regression analyses using the Original Study Exclusion Criteria (reported in Tables 4.44, 4.45, 4.46 and 4.47) and results using Exclusion Criteria A and Exclusion Criteria B are reported in Appendix H (Table H.4).

A comparison of results using Exclusion Criteria A and results using the Original Study Exclusion Criteria showed that the corresponding regression coefficients were similar (i.e., within ± 0.75 FIM units) for each of the 4 Groups. The

regression coefficients were also similar (i.e., within ± 0.75 FIM units) when Exclusion Criteria B and the Study Exclusion Criteria were applied.

Summary of Multiple Linear Regression Results – 1997 Hip Fracture Database

The multiple linear regression analysis of the 1997 hip fracture database found that discharge motor FIM ratings for patients with hip fracture were not different for IRFs and SNFs after adjusting for covariates.

Research Question 3: Did Medicare Payments for Patients with Hip Fracture Treated in IRFs Differ from Medicare Payments for Patients Treated in SNF-Based Rehabilitation Care across all Case-Mix Groups in 1997?

Payments to Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) – 1997 Hip Fracture Database

In the 1997 hip fracture database, the median unadjusted Medicare Part A payment per patient was $9,672 for IRFs and $6,289 (both in 1997 U.S. Dollars) for SNF-based rehabilitation programs.

When payment amounts were standardized to reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or

indirect medical education, the difference remained statistically significant, with a median payment per patient for IRFs of $9,906, and the median for SNF-based rehabilitation programs of $6,107, an adjusted difference of $3,799.

The sum of payments received by the facility from Medicare Part A, other primary payers and patients was $9,860 per patient for IRFs, and $6,653 per patient for SNF-based rehabilitation programs.

For some rehabilitation stays, patients were responsible for paying a deductible, co-insurance or a blood deductible. Approximately 85 percent of IRF patients had no liability, whereas 53.1 percent of SNF patients had no liability.

Table 4.35 shows the payment data described above, as well as additional statistics for each payment variable, including the mean, standard deviation, median, 25th and 75th percentile and minimum and maximum amounts. Significance levels were determined using the Mann-Whitney *U* procedure.

Medicare Payments and Length of Stay by Case-Mix Group – 1997 Hip Fracture Database

When payment data were analyzed separately by Case-Mix Group (Table 4.36), the unadjusted and standardized Medicare Part A payments remained significantly higher in IRFs across all 5 groups.

Table 4.35 Medicare Part A Payment Data for Fee-for-Service Patients with Hip Fracture by Rehabilitation Setting, 1997 (n = 15,336)

Type of Payment	Inpatient Rehabilitation Facility (n=12,228)	Skilled Nursing Facility (n=3,108)	P
Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
Mean (SD)	10,851 (6,144)	7,454 (5,226)	
Median	9,672	6,289	
25th and 75th percentiles	6,646 –13,722	3,894 – 9,795	
Minimum and maximum	0 — 66,128	0 — 37,785	
Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
Mean (SD)	11,261 (6,506)	7,190 (4,922)	
Median	9,906	6,107	
25th and 75th percentiles	6,827 – 14,317	3,909 – 9,292	
Minimum and maximum	0 — 63,098	0 — 40,554	
Payments to facility* (1997 U.S. Dollars)			< .001
Mean (SD)	11,088 (6,201)	8,216 (6,144)	
Median	9,860	6,653	
25th and 75th percentiles	6,851 – 13,870	4,077 – 10,623	
Minimum and Maximum	0 — 89,219	0 — 43,865	
Patient liability (1997 U.S. Dollars)			< .001
Percent of patients with liability	85.0	53.1	
Mean (SD)	131 (457)	716 (1,291)	
Median	0	0	
25th and 75th percentiles	0 – 0	0 – 950	
Minimum and maximum	0 — 12,540	0 — 7,629	

USD = United States Dollars; SD = standard deviation; DRG = Diagnosis-Related Group
Significance levels determined using Mann-Whitney *U* procedure.
Patient liability includes co-insurance and deductibles. Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education.
* Payments from Medicare Part A, other primary payers and patients; does not include payments from Medicare Part B.

As the severity level increased, the difference between the standardized payments per patient to IRFs and SNFs also increased. For Case-Mix Group 701, the difference between the median IRF payment and the median SNF payment was $2,398; the median IRF payment was 50.4% higher than the median SNF payment. The difference increased to $3,071 (52.8% higher than the median SNF payment) for Case-Mix Group 702, and $4,041 (66.4% higher

than the median SNF payment) for Case-Mix Group 703. For Case-Mix Group 704, the difference was $4,583 (68.9% higher than the median SNF payment), and $5,773 (81.4% higher than the median SNF payment) for Case-Mix Group 705.

Across each Case-Mix Group, the rehabilitation length of stay (LOS) was significantly shorter for patients in IRFs when compared to patients in SNFs. For patients in Case-Mix Group 701, the median LOS was 11 days for IRFs and 14 days for SNFs, a difference of 3 days. For the remaining Case-Mix Groups, the median lengths of stay for IRFs and SNFs were 13 and 19 for Case-Mix Group 702, 15 and 19 days for Case-Mix Group 703, 16 and 22 for Case-Mix Group 704 and 18 and 23 for Case-Mix Group 705, respectively.

Summary of Medicare Payment Analyses – 1997 Hip Fracture Database

Medicare payments per patient to IRFs were higher than SNF payments across all 5 Case-Mix Groups. The LOS for patients in IRFs was significantly shorter than the LOS for patients in SNFs.

Table 4.36 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Hip Fracture by Case-Mix Group and by Rehabilitation Setting, 1997 (n = 15,336)

Case-Mix Group	Variable	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
701	**Number of patient records**	**2,184**	**547**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	7,794 (4,200)	5,310 (3,569)	
	Median	7,000	4,573	
	25th and 75th percentiles	4,997 – 9,724	2,775 – 7,125	
	Minimum and maximum	0 — 34,708	0 — 26,253	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	8,005 (4,407)	5,244 (3,421)	
	Median	7,160	4,762	
	25th and 75th percentiles	5,194 – 9,879	2,805 – 6,917	
	Minimum and maximum	0 — 35,032	0 — 27,425	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	11.9 (5.6)	16.3 (10.3)	
	Median	11	14	
	25th and 75th percentiles	8 – 15	9 – 20	
	Minimum and maximum	4 — 52	4 — 82	
702	**Number of patient records**	**2,893**	**652**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	9,438 (5,020)	6,567 (4,124)	
	Median	8,645	5,928	
	25th and 75th percentiles	6,230 - 11,664	3,648 – 8,447	
	Minimum and maximum	0 — 50,803	0 — 30,035	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	9,733 (5,183)	6,455 (3,893)	
	Median	8,883	5,812	
	25th and 75th percentiles	6,347 – 12,028	3,587 – 8,355	
	Minimum and maximum	0 — 41,316	0 — 29,334	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	14.2 (6.7)	20.9 (12.6)	
	Median	13	19	
	25th and 75th percentiles	10 – 17	13 – 26	
	Minimum and maximum	4 — 65	4 — 99	

Table 4.50 (cont'd)

Case-Mix Group	Variable	IRF	SNF	P
703	**Number of patient records**	**1,980**	**473**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	10,961 (5,587)	7,107 (4,270)	
	Median	9,920	6,445	
	25th and 75th percentiles	7,366 – 13,791	4,145 – 9,606	
	Minimum and maximum	0 — 51,480	0 — 32,401	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	11,373 (5,987)	6,886 (4,026)	
	Median	10,126	6,085	
	25th and 75th percentiles	7,442 – 14,243	4,054 – 9,542	
	Minimum and maximum	0 — 47,547	0 — 23,280	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	16.1 (7.1)	23.1 (14.6)	
	Median	15	19	
	25th and 75th percentiles	11 – 20	14 – 28	
	Minimum and maximum	4 — 61	4 — 118	
704	**Number of patient records**	**1,665**	**389**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	11,849 (6,073)	8,214 (5,282)	
	Median	10,872	7,264	
	25th and 75th percentiles	7,736 – 14,932	4,677 – 10,825	
	Minimum and maximum	0 — 48,938	0 — 27,910	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	11,236 (6,425)	7,824 (5,067)	
	Median	11,236	6,653	
	25th and 75th percentiles	7,818 - 15,366	4,596 – 10,135	
	Minimum and maximum	0 — 51,436	0 — 28,144	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	17.5 (8.0)	25.6 (14.8)	
	Median	16	22	
	25th and 75th percentiles	12 – 21	15.5 – 32	
	Minimum and maximum	4 — 64	5 — 89	

Table 4.50 (cont'd)

Case-Mix Group	Variable	IRF	SNF	P
705	**Number of patient records**	**3,506**	**1,047**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	13,384 (7,097)	9,001 (6,305)	
	Median	12,155	7,304	
	25th and 75th percentiles	8,629 – 16,727	4,539 – 11,980	
	Minimum and maximum	0 — 66,128	0 — 37,785	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	14,014 (7549)	8,567 (5,931)	
	Median	12,862	7,089	
	25th and 75th percentiles	8,920 – 17,630	4,495 – 11,288	
	Minimum and maximum	0 — 63,098	0 — 40,554	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	19.3 (9.1)	27.5 (17.1)	
	Median	18	23	
	25th and 75th percentiles	13 – 23	15 – 35	
	Minimum and maximum	4 — 73	4 — 105	

SD refers to standard deviation.

Significance levels determined using Mann-Whitney *U* procedure.

Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education.

Results from the Combined 1996 and 1997 Hip Fracture Databases

The 1996 hip fracture database and the 1997 hip fracture database were combined, and the outcomes and payment analyses were conducted on the combined databases.

Research Question 1: Did the Percentage of Patients with Hip Fracture Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1996 and 1997?

Preparing Data for Logistic Regression Analyses

Logistic regression was used to test whether the percentage of patients with hip fractures discharged to the community was different for IRFs and SNFs in the combined 1996 and 1997 hip fracture databases. A community-based discharge was defined as a discharge setting of home (house or apartment), a board and care setting or a transitional living setting, and was coded as a “1.” All other discharge destinations were coded as “0.” Covariates were entered into the regression model prior to the rehabilitation setting variable in order to control for differences in patient and facility-level market factors prior to testing the effect of the rehabilitation setting.

The data from the combined 1996 and 1997 hip fracture database were stratified into the 4 case-mix/age groups, based on the previous analyses of the 1996 and the 1997 databases. The 4 groups were: 1) the records of patients with mild to moderate disability (Case-Mix Groups 701, 702 and 703) who were 82 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 701, 702 and 703) who were 83 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 704 and 705) who were 82 years of age or younger, 4) and the records of patients with severe disability (Case-Mix Groups 704 and 705) who were 83 years of age or older.

Once data records were stratified into the 4 case-mix/age groups, the distribution of each continuous covariate was examined. If indicated, data were transformed using the procedure that resulted in the lowest Kolmogorov-Smirnov statistic.

Correlations between each of the transformed covariates and the independent variable were assessed for the potential of multicollinearity. The strongest correlations for the 4 groups were 0.26 (between the transformed values of median household income and managed care penetration) for the first group, 0.27 (between the transformed values of median household income and managed care penetration) for the second group, 0.40 (between the transformed values of the admission motor FIM ratings and admission cognitive FIM ratings) for the third group and 0.41 (between transformed values of the admission motor FIM ratings and admission cognitive FIM ratings) for the fourth group.

The Percent of Patients Discharged to the Community from Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The percent of community-based discharges for each setting, *prior* to adjusting for the influence of covariates, were calculated, and are reported in Table 4.37.

For younger patients (Group 1 and Group 3), the *unadjusted* percentages of patients discharged to community-based settings from IRFs and SNFs were not significantly different (p = .401 for Group 1, p = .838 for Group 3). For patients older than 82 years of age, (Group 2 and Group 4), those admitted to SNFs were more likely to be discharged to a community-based setting (p = .014 for Group 2, p = .003 for Group 4).

Table 4.37 Unadjusted Percent of Patients with Hip Fracture Discharged to Community-Based Settings by Rehabilitation Setting, 1996 and 1997 (n = 29,793)

Group		Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	**Mild to Moderate Disability & age ≤ 82 years**	92.8% (n= 9,132)	93.4% (n = 1,480)	.401
2	**Mild to Moderate Disability & age ≥ 83 years**	84.6% (n = 5,513)	87.4% (n = 1,226)	.014
3	**Severe Disability & age ≤ 82 years**	75.4% (n = 4,926)	75.7% (n = 955)	.838
4	**Severe Disability & age ≥ 83 years**	63.2% (n = 5,143)	67.5% (n = 1,418)	.003

Significance levels determined using Chi-square procedure.

Logistic Regression Analyses of Data in the 1996 and 1997 Hip Fracture Database

Results of the logistic regression analyses for each of the 4 groups are reported in Tables 4.38, 4.39, 4.40 and 4.41.

Among younger patients with mild to moderate disability (Group 1; Table 4.38), after controlling for covariates, the percentage of patients discharged to community-based settings for the 2 rehabilitation settings was not statistically different ($p = .583$).

For older patients (Group 2; Table 4.39 and Group 4; Table 4.41) and for younger patients with severe disabilities (Group 3; Table 4.40), after controlling for covariates, patients treated in SNF-based programs were more likely to return to the community ($p = .012$ for Group 2, $p = .028$ for Group 3, $p < .001$ for Group 4). The adjusted odds ratios were 0.78 (95% CI: 0.64 to 0.95) for Group 2, 0.82 (95% CI: 0.68 to 0.98) for Group 3, and 0.73 (95% CI: 0.63 to 0.84) for Group 4.

Table 4.38 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger, Combined 1996 and 1997 Hip Fracture Databases (n = 10,612)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time (*logarithm base 10*)	-0.265	0.141	3.51	0.061	0.77	0.58	1.01
Admission motor FIM rating (*logarithm base 10*)	9.113	0.939	94.22	0.000	9075	1441.1	57151
Admission cognitive FIM rating (*square*)	0.001	0.000	116.5	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.409	0.079	26.76	< .001	0.66	0.57	0.78
Tier 1 comorbidity (present =1)	-0.098	0.624	0.02	0.876	0.91	0.27	3.08
Tier 2 comorbidity (present =1)	-0.525	0.195	7.22	0.007	0.59	0.40	0.87
Tier 3 comorbidity (present =1)	-0.070	0.137	0.26	0.612	0.93	0.71	1.22
Age (*cube)*	0.000	0.000	13.85	< .001	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-0.684	0.080	73.91	< .001	0.50	0.43	0.59
Median household income (*logarithm base 10*)	-0.074	0.261	0.08	0.775	0.93	0.56	1.55
Sex (female =1)	-0.112	0.101	1.24	0.265	0.89	0.73	1.09
Race (white =1)	-0.198	0.164	1.46	0.228	0.82	0.59	1.13
Volume of patients (*logarithm base 10*)	0.124	0.117	1.14	0.286	1.13	0.90	1.42
County managed care penetration (*no transformation*)	0.054	0.249	0.05	0.827	1.06	0.65	1.72
Rehabilitation setting (IRF=1, SNF=0)	-0.065	0.119	0.30	0.583	0.94	0.74	1.18
Constant	-12.67	1.922	43.46	< .001	0.00	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.39 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older, Combined 1996 and 1997 Hip Fracture Databases (n = 6,739)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time (*logarithm base 10*)	0.040	0.124	0.11	0.745	1.04	0.82	1.33
Admission motor FIM rating (*logarithm base 10*)	7.575	0.875	74.99	< .001	1948	350.78	10818
Admission cognitive FIM rating (*square*)	0.001	0.000	75.75	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.250	0.072	12.12	< .001	0.78	0.68	0.90
Tier 1 comorbidity (present =1)	0.302	0.783	0.15	0.700	1.35	0.29	6.27
Tier 2 comorbidity (present =1)	-0.374	0.195	3.70	0.055	0.69	0.47	1.01
Tier 3 comorbidity (present =1)	0.018	0.163	0.01	0.913	1.02	0.74	1.40
Age (*logarithm base 10*)	-10.62	1.980	28.81	< .001	0.00	0.00	0.00
Pre-hospital living alone (alone =1)	-0.532	0.075	51.00	< .001	0.59	0.51	0.68
Median household income (*logarithm base 10*)	-0.404	0.244	2.74	0.098	0.67	0.41	1.08
Sex (female =1)	-0.133	0.105	1.61	0.205	0.88	0.71	1.08
Race (white =1)	0.264	0.208	1.61	0.204	1.30	0.87	1.96
Volume of patients (*logarithm base 10*)	0.201	0.109	3.41	0.065	1.22	0.99	1.51
County managed care penetration (*no transformation*)	0.406	0.224	3.29	0.070	1.50	0.97	2.33
Rehabilitation setting (IRF=1, SNF=0)	-0.252	0.100	6.35	0.012	0.78	0.64	0.95
Constant	10.53	4.313	5.96	0.015	37470	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.40 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger, Combined 1996 and 1997 Hip Fracture Databases (n = 5,881)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	0.221	0.107	4.24	0.039	1.25	1.01	1.54
Admission motor FIM rating (*square*)	0.001	0.000	134.2	< .001	1.00	1.00	1.00
Admission cognitive FIM rating (*square*)	0.001	0.000	69.81	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.201	0.065	9.66	0.002	0.82	0.72	0.93
Tier 1 comorbidity (present =1)	0.680	0.505	1.82	0.178	1.97	0.73	5.31
Tier 2 comorbidity (present =1)	-0.198	0.136	2.13	0.145	0.82	0.63	1.07
Tier 3 comorbidity (present =1)	-0.051	0.089	0.33	0.568	0.95	0.80	1.13
Age (*cube*)	0.000	0.000	9.15	0.002	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-0.564	0.069	67.75	< .001	0.57	0.50	0.65
Median household income (*logarithm base 10*)	-0.233	0.212	1.21	0.271	0.79	0.52	1.20
Sex (female =1)	0.072	0.072	1.02	0.314	1.07	0.93	1.24
Race (white =1)	0.129	0.121	1.14	0.285	1.14	0.90	1.44
Volume of patients (*square root*)	0.025	0.009	7.49	0.006	1.03	1.01	1.04
County managed care penetration (*no transformation*)	-0.119	0.198	0.36	0.548	0.89	0.60	1.31
Rehabilitation setting (IRF=1, SNF=0)	-0.201	0.091	4.85	0.028	0.82	0.68	0.98
Constant	0.993	0.974	1.04	0.308	2.70	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.41 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting for Patients with Severe Disabilities (Case-Mix Groups 704 and 705) and 83 Years of Age or Older, , combined 1996 and 1997 Hip Fracture Databases (n = 6,561)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time *(logarithm base 10)*	0.055	0.093	0.35	0.557	1.06	0.88	1.27
Admission motor FIM rating *(square)*	0.001	0.000	169.9	< .001	1.00	1.00	1.00
Admission cognitive FIM rating *(square)*	0.001	0.000	53.68	< .001	1.00	1.00	1.00
Type of hip fracture (Extracapsular fracture = 1)	-0.285	0.054	27.41	< .001	0.75	0.68	0.84
Tier 1 comorbidity (present =1)	0.695	0.603	1.33	0.249	2.00	0.61	6.53
Tier 2 comorbidity (present =1)	-0.329	0.119	7.66	0.006	0.72	0.57	0.91
Tier 3 comorbidity (present =1)	-0.162	0.097	2.77	0.096	0.85	0.70	1.03
Age (*logarithm base 10*)	-4.089	1.414	8.37	0.004	0.02	0.00	0.27
Pre-hospital living alone (alone =1)	-0.592	0.056	110.5	< .001	0.55	0.50	0.62
Median household income (*logarithm base 10*)	-0.213	0.181	1.38	0.240	0.81	0.57	1.15
Sex (female =1)	-0.097	0.070	1.92	0.166	0.91	0.79	1.04
Race (white =1)	0.285	0.113	6.30	0.012	1.33	1.06	1.66
Volume of patients (*logarithm base 10*)	0.036	0.080	0.20	0.655	1.04	0.89	1.21
County managed care penetration (*no transformation*)	0.017	0.165	0.01	0.917	1.02	0.74	1.41
Rehabilitation setting (IRF=1, SNF=0)	-0.314	0.073	18.59	< .001	0.73	0.63	0.84
Constant	8.658	2.885	9.01	0.003	5758.7	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Post-Hoc Power Analyses for Logistic Regression Results – 1996 Hip Fracture Database

The estimated power of the logistic regression analyses were calculated post-hoc to support interpretations of the results (Table 4.42). For analyses with an alpha of 0.05 and a 5 percent difference in rates considered as clinically important, estimated power was 99 percent for the first and second groups, 91 percent for the third group, and 93 percent for the fourth group.

Table 4.42 Post-Hoc Power Estimates for Logistic Regression Analyses, 1996 and 1997 Hip Fracture Databases (n = 29,793)

Group		IRF: number	SNF: number	Community Discharge – Percent		Alpha	Estimated Power
				low	high		
1	Mild to Moderate Disability & age ≤ 82 years	9,132	1,480	90	95	.05	.99
2	Mild to Moderate Disability & age ≥ 83 years	5,513	1,226	84	89	.05	.99
3	Severe Disability & age ≤ 82 years	4,926	955	75	80	.05	.91
4	Severe Disability & age ≥ 83 years	5,143	1,418	63	68	.05	.93

IRF refers to Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Summary of Logistic Regression Analyses of the 1996 and 1997 Hip Fracture Databases

In summary, the logistic regression analyses of the combined 1996 and 1997 hip fracture databases showed that, among patients with mild to moderate disability

who were 82 years old or younger, the percent of patients with hip fractures discharged to community-based settings was not different for IRFs and SNFs.

Among older patients with mild to moderate disabilities, and patients with severe disabilities, a slightly higher percentage of patients treated in SNFs were discharged to the community, after adjusting for covariates.

Research Question 2: Did the Functional Outcomes of Patients with Hip Fracture Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1996 and 1997?

Preparing Data for Multiple Linear Regression Analyses

Multiple linear regression was used to test whether the discharge motor function status of patients with hip fractures was different if the patient received rehabilitation care in an IRF or a SNF. The motor FIM ratings collected within the last 3 days of a patient's rehabilitation stay were used as the dependent variable in the regression models.

The combined 1996 and 1997 hip fracture databases were stratified into 4 groups based on Case-Mix Group assignment and the median age of 82 years. The 4 groups, which were the same groups used in the logistic regression analyses, were: 1) the records of patients with mild to moderate disability (Case-

Mix Groups 701, 702 and 703) who were 82 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 701, 702 and 703) who were 83 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 704 and 705) who were 82 years of age or younger, 4) and the records of patients with severe disability (Case-Mix Groups 704 and 705) who were 83 years of age or older.

As described previously (in the logistic regression analysis section), some of the continuous variables were transformed, and correlations of the transformed covariates and the independent variable were all weaker than 0.5.

Discharge Motor FIM Ratings of Patients Treated in Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The *unadjusted* mean, standard deviation and median discharge motor FIM ratings for each of the 4 groups was calculated (Table 4.43). These data show statistically significant different motor FIM ratings for each of the 4 groups. Average *SNF* ratings were higher for the first two groups, with differences of 0.5 and 0.9 FIM units. Mean *IRF* ratings were higher for the patients with severe disability (Groups 3 & 4) by differences of 2.4 and 1.5 FIM units.

As previously described, for this study, only differences of 2 or more motor FIM units were considered clinically important.

Table 4.43 Unadjusted Mean, Standard Deviation, and Median Discharge Motor FIM Ratings of Patients with Hip Fractures by Group, 1996 and 1997 (n = 29,793)

Group		Description	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	Mild to moderate disability & 82 years of age or younger	Number	9,132	1,480	.003
		Mean (SD)	73.8 (7.6)	74.3 (8.2)	
		Median	75	76	
2	Mild to moderate disability & 83 years of age or older	Number	5,513	1,226	< .001
		Mean (SD)	71.1 (8.2)	72.0 (9.0)	
		Median	72	74	
3	Severe disability & 82 years of age or younger	Number	4,926	955	< .001
		Mean (SD)	59.1 (14.6)	56.7 (16.5)	
		Median	61	59	
4	Severe disability & 83 years of age or older	Number	5,143	1,418	.029
		Mean (SD)	55.8 (14.2)	54.3 (16.8)	
		Median	57	56	

FIM refers to Functional Independence Measure; P, probability; SD, standard deviation
Significance levels determined using Mann-Whitney U procedure.

In the analyses of the discharge motor FIM ratings, prior to any adjustments, statistically significant results were detected for all 4 groups, but the differences between the mean ratings were less than 2 FIM units for 3 of the 4 groups. For Group 3, average IRF ratings was higher by 2.4 FIM units.

Multiple Linear Regression Results -- 1996 and 1997 Hip Fracture Databases

Results of the multiple regression analyses for each of the 4 case-mix/age groups are reported in tables 4.44, 4.45, 4.46 and 4.47.

After controlling for covariates, no statistically significant effect was detected for the patients with mild to moderate disabilities who were 82 years of age or younger (Group 1; Table 4.44; p = .165), patients with severe disabilities who

were 82 years of age and younger (Group 3; Table 4.46; p = .182), and patients with severe disability who were 83 years of age and older (Group 4; Table 4.47; p = .132).

For the patients with mild to moderate disability who were 83 years of age and older (Group 2; Table 4.45), after controlling for covariates, a statistically significant effect of -0.65 was detected (p = .007; 95% CI: -1.13 to -0.18; R^2 change = .001). Thus, patients discharged from SNFs achieved a higher mean discharge FIM rating of less than 1 point compared to patients discharged from IRFs. This is a small effect that may not be clinically important.

Multicollinearity did not appear to be a concern; the highest variance inflation factor values were below the value of 4, which could indicate a potential problem.[113] The values were 1.132 for Group 1, 1.135 for Group 2, 1.231 for Group 3 and 1.241 for the last group.

Histograms of the standardized regression residuals showed residuals were generally normally distributed, addressing the regression assumption of normality.[113]

Table 4.44 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger, Combined 1996 and 1997 Hip Fracture Databases (n = 10,612)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	-31.13	3.00	--	-10.39	< .001	-37.00	-25.26
Onset time (*logarithm base 10*)	-1.72	0.24	-0.06	-7.04	< .001	-2.20	-1.24
Admission motor FIM rating (*logarithm base 10*)	55.06	1.39	0.35	39.48	< .001	52.33	57.80
Admission cognitive FIM rating (*square*)	0.01	0.00	0.23	26.30	< .001	0.01	0.01
Type of hip fracture (Extracapsular fracture = 1)	-0.73	0.14	-0.04	-5.23	< .001	-1.01	-0.46
Tier 1 comorbidity (present =1)	-2.62	1.22	-0.02	-2.16	0.031	-5.01	-0.24
Tier 2 comorbidity (present =1)	-0.63	0.42	-0.01	-1.49	0.135	-1.46	0.20
Tier 3 comorbidity (present =1)	-1.02	0.24	-0.04	-4.18	< .001	-1.49	-0.54
Age (*cube*)	0.00	0.00	-0.02	-1.77	0.077	0.00	0.00
Pre-hospital living alone (alone =1)	1.27	0.14	0.08	9.30	< .001	1.00	1.54
Median household income (*logarithm base 10*)	0.94	0.44	0.02	2.12	0.034	0.07	1.81
Sex (female = 1)	0.00	0.16	0.00	0.01	0.991	-0.32	0.32
Race (white = 1)	0.01	0.30	0.00	0.04	0.969	-0.57	0.59
Volume of patients (*logarithm base 10*)	0.46	0.20	0.02	2.28	0.022	0.06	0.85
County managed care penetration (*no transformation*)	0.49	0.43	0.01	1.15	0.252	-0.35	1.33
Rehabilitation setting (IRF = 1, SNF = 0)	-0.27	0.20	-0.01	-1.39	0.165	-0.66	0.11

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.45 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older, Combined 1996 and 1997 Hip Fracture Databases (n = 6,739)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	47.63	11.28	--	4.22	< .001	25.53	69.74
Onset time (*logarithm base 10*)	-1.68	0.32	-0.06	-5.33	< .001	-2.30	-1.06
Admission motor FIM rating (*logarithm base 10*)	62.56	1.99	0.34	31.39	< .001	58.66	66.47
Admission cognitive FIM rating (*square*)	0.01	0.00	0.23	21.23	< .001	0.01	0.01
Type of hip fracture (Extracapsular fracture = 1)	-1.04	0.19	-0.06	-5.57	< .001	-1.41	-0.67
Tier 1 comorbidity (present =1)	-0.36	1.89	0.00	-0.19	0.849	-4.07	3.35
Tier 2 comorbidity (present =1)	-0.30	0.56	-0.01	-0.53	0.598	-1.40	0.80
Tier 3 comorbidity (present =1)	-0.74	0.41	-0.02	-1.79	0.073	-1.54	0.07
Age (*logarithm base 10*)	-48.23	5.28	-0.10	-9.14	< .001	-58.57	-37.88
Pre-hospital living alone (alone =1)	1.17	0.18	0.07	6.34	< .001	0.81	1.53
Median household income (*logarithm base 10*)	1.12	0.61	0.02	1.84	0.065	-0.07	2.32
Sex (female = 1)	-0.17	0.25	-0.01	-0.66	0.511	-0.66	0.33
Race (white = 1)	-0.23	0.48	-0.01	-0.48	0.630	-1.18	0.72
Volume of patients (*logarithm base 10*)	0.10	0.28	0.00	0.35	0.727	-0.45	0.64
County managed care penetration (*no transformation*)	0.88	0.57	0.02	1.55	0.121	-0.23	1.99
Rehabilitation setting (IRF = 1, SNF = 0)	-0.65	0.24	-0.03	-2.69	0.007	-1.13	-0.18

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.46 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger, Combined 1996 and 1997 Hip Fracture Databases (n = 5,881)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	16.87	4.53	--	3.72	< .001	7.99	25.75
Onset time (*logarithm base 10*)	-2.06	0.51	-0.04	-4.04	< .001	-3.07	-1.06
Admission motor FIM rating (*square*)	0.02	0.00	0.48	43.91	< .001	0.02	0.02
Admission cognitive FIM rating (*square*)	0.01	0.00	0.26	23.88	< .001	0.01	0.01
Type of hip fracture (Extracapsular fracture = 1)	-0.46	0.30	-0.02	-1.53	0.127	-1.06	0.13
Tier 1 comorbidity (present =1)	-1.00	1.91	-0.01	-0.53	0.600	-4.75	2.74
Tier 2 comorbidity (present =1)	-1.54	0.68	-0.02	-2.28	0.022	-2.87	-0.22
Tier 3 comorbidity (present =1)	-1.99	0.42	-0.05	-4.73	< .001	-2.82	-1.16
Age (*cube*)	0.00	0.00	-0.01	-0.79	0.428	0.00	0.00
Pre-hospital living alone (alone =1)	2.68	0.33	0.08	8.24	< .001	2.04	3.32
Median household income (*logarithm base 10*)	3.09	0.98	0.03	3.14	0.002	1.16	5.02
Sex (female = 1)	0.20	0.33	0.01	0.59	0.552	-0.46	0.85
Race (white = 1)	-1.07	0.55	-0.02	-1.96	0.051	-2.14	0.00
Volume of patients (*square root*)	0.10	0.04	0.02	2.37	0.018	0.02	0.18
County managed care penetration (*no transformation*)	-0.67	0.93	-0.01	-0.72	0.471	-2.48	1.15
Rehabilitation setting (IRF = 1, SNF = 0)	0.56	0.42	0.01	1.33	0.182	-0.26	1.39

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.47 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older, Combined 1996 and 1997 Hip Fracture Databases (n = 6,561)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	138.3	14.48	--	9.55	< .001	109.9	166.7
Onset time (*logarithm base 10*)	-2.09	0.47	-0.04	-4.47	< .001	-3.01	-1.18
Admission motor FIM rating (*square*)	0.02	0.00	0.50	49.6	< .001	0.02	0.02
Admission cognitive FIM rating (*square*)	0.01	0.00	0.26	26.0	< .001	0.01	0.01
Type of hip fracture (Extracapsular fracture = 1)	-0.90	0.27	-0.03	-3.28	0.001	-1.44	-0.36
Tier 1 comorbidity (present =1)	-0.99	2.80	0.00	-0.35	0.724	-6.49	4.50
Tier 2 comorbidity (present =1)	-1.53	0.61	-0.02	-2.49	0.013	-2.74	-0.33
Tier 3 comorbidity (present =1)	-1.10	0.49	-0.02	-2.24	0.025	-2.07	-0.14
Age (*logarithm base 10*)	-64.89	7.10	-0.08	-9.14	< .001	-78.81	-50.98
Pre-hospital living alone (alone =1)	1.86	0.28	0.06	6.64	< .001	1.31	2.41
Median household income (*logarithm base 10*)	3.99	0.90	0.04	4.42	< .001	2.22	5.75
Sex (female = 1)	-0.23	0.34	-0.01	-0.67	0.502	-0.90	0.44
Race (white = 1)	-0.49	0.55	-0.01	-0.89	0.372	-1.57	0.59
Volume of patients (*logarithm base 10*)	0.24	0.40	0.01	0.61	0.542	-0.54	1.03
County managed care penetration (*no transformation*)	-0.97	0.83	-0.01	-1.18	0.238	-2.59	0.64
Rehabilitation setting (IRF = 1, SNF = 0)	-0.54	0.36	-0.01	-1.51	0.132	-1.24	0.16

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Post-Hoc Power Analyses for Multiple Linear Regression Results – 1996 and 1997 Hip Fracture Databases

The estimated power of each analysis was calculated post-hoc to assist with interpretation of the results. As shown in Table 4.48, the estimated power for these analyses with an alpha of 0.05 and small effect size, was 99 percent for all 4 groups.

Table 4.48 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1996 and 1997 Hip Fracture Databases (n = 29,793)

	Group	Number of Patient Records	Adjusted R^2	Effect Size: Incremental R^2 Increase	Alpha	Estimated Power
1	**Mild to Moderate Disability & age ≤ 82 years**	10,612	.237	.005	.05	.99
2	**Mild to Moderate Disability & age ≥ 83 years**	6,739	.242	.005	.05	.99
3	**Severe Disability & age ≤ 82 years**	5,881	.437	.005	.05	.99
4	**Severe Disability & age ≥ 83 years**	6,561	.466	.005	.05	.99

R^2 refers to multiple coefficient of determination

Research Question 3: Did Medicare Payments for Patients with Hip Fracture Treated in IRFs Differ from Medicare Payments for Patients Treated in SNF-Based Rehabilitation Care Across All Case-Mix Groups in 1996 and 1997?

Payments to Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facility (SNFs) – 1996 and 1997 Hip Fracture Databases

In the combined 1996 and 1997 hip fracture databases, the median unadjusted Medicare Part A payment per patient was $9,589 for IRFs and $6,288 (both in 1997 U.S. Dollars) for SNF-based rehabilitation programs.

When payment amounts were standardized, the difference remained statistically significant. The median standardized payment per patient to IRFs was $9,815, and the median payment per patient to SNF-based rehabilitation programs was $6,088, a difference of $3,727 (median IRF payment was 61.2% higher than the median SNF payment).

The median of the sum of payments received by the facility from Medicare Part A, other primary payers and patients, was $9,860 for IRF patients and $6,653 for patients discharged from SNF-based rehabilitation programs.

For some rehabilitation stays, patients were responsible for paying a deductible, co-insurance or a blood deductible. Approximately 85.6 percent of IRF patients and 52.2 percent of SNF patients had no liability.

Payment data are reported in Table 4.49. P values reported in the table are based on the Mann-Whitney *U* test.

Table 4.49 Medicare Part A Payment Data for Fee-for-Service Patients with Hip Fracture by Rehabilitation Setting, 1996 and 1997 (n = 29,793)

Type of Payment	Inpatient Rehabilitation Facility (n=24,714)	Skilled Nursing Facility (n=5,079)	P
Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
Mean (SD)	10,724 (6,138)	7,462 (5,252)	
Median	9,589	6,288	
25th and 75th percentiles	6,572 – 13,570	3,941 – 9,686	
Minimum and maximum	0 — 66,128	0 — 37,785	
Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
Mean (SD)	11,124 (6,528)	7,238 (5,051)	
Median	9,815	6,088	
25th and 75th percentiles	6,721 – 14,134	3,946 – 9,255	
Minimum and maximum	0 — 63,098	0 — 40,554	
Payments to facility* (1997 U.S. Dollars)			< .001
Mean (SD)	11,088 (6,201)	8,216 (6,144)	
Median	9,860	6,653	
25th and 75th percentiles	6,851 – 13,870	4,077 – 10,623	
Minimum and Maximum	0 — 89,219	0 — 43,865	
Patient liability (1997 U.S. Dollars)			< .001
Patients with liability (%)	85.6	52.2	
Mean (SD)	132 (485)	718 (1,264)	
Median	0	0	
25th and 75th percentiles	0 – 0	0 – 950	
Minimum and maximum	0 — 18,584	0 — 7,676	

SD refers to standard deviation.
Significance levels determined using Mann-Whitney *U* procedure.
Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education. Patient liability includes co-insurance and deductibles.
* Payments from Medicare Part A, other primary payers and patients; does not include payments from Medicare Part B.

Medicare Payments and Length of Stay by Case-Mix Group – 1996 and 1997 Hip Fracture Databases

When 1996 and 1997 payment data were analyzed by Case-Mix Group (Table 4.50), the unadjusted and standardized Medicare Part A payments remained statistically significantly different across all 5 groups, with IRF payments always higher.

As the Case-Mix Groups increased in severity (i.e., from 701 to 705), the difference in the standardized payment also increased. For Case-Mix Group 701, the difference between the median standardized IRF payment and the median standardized SNF payment was $2,740; the IRF payment was 60.5 percent higher than SNF payment. The difference increased to $3,070 (53.5% higher than SNF payment) for Case-Mix Group 702, $4,092 (67.8% higher than SNF payment) for Case-Mix Group 703, $4,674 (71.2% higher than SNF payment) for Case-Mix Group 704, and $5,312 (73.4% higher than SNF payment) for Case-Mix Group 705.

Across each Case-Mix Group, the rehabilitation length of stay (LOS) was significantly shorter for patients in IRFs when compared to patients with stays in SNFs. For patients in Case-Mix Group 701, the median LOS was 11 days for IRFs and 14 days for SNFs, a difference of 3 days. For the remaining Case-Mix Groups, the median stays for IRFs and SNFs were 14 and 19 days for Case-Mix

Group 702 (a difference of 5 days), 15 and 19 days for Case-Mix Group 703 (a difference of 4 days), 16 and 22 days for Case-Mix Group 704 (a difference of 6 days) and 18 and 23 days for Case-Mix Group 705 (a difference of 5 days).

Summary of Medicare Payment Analyses – 1996 and 1997 Hip Fracture Databases

In summary, Medicare Part A payments to IRFs were found to be significantly higher than payments made to SNFs for patients with hip fracture in 1996 and 1997 using the Mann-Whitney *U* procedure. Differences remained between the median standardized payments when data were stratified into the 5 Case-Mix Groups, ranging from $2,740 for Case-Mix Group 701 to $5,312 for Case-Mix Group 705.

Although payments to IRFs were higher, the median stays for patients in IRFs were significantly shorter than the stays for patients in SNFs when stratified by Case-Mix Group.

Table 4.50 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Hip Fracture by Case-Mix Group and by Rehabilitation Setting, 1996 and 1997 (n = 29,793)

Case-Mix Group	Variable	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
701	**Number of patient records**	**4,603**	**896**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	7,819 (4,249)	5,227 (3,597)	
	Median	7,141	4,555	
	25th and 75th percentiles	4,991 – 9,768	2,700 – 6,921	
	Minimum and maximum	0 — 34,708	0 — 27,110	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	7,983 (4,399)	5,197 (3,538)	
	Median	7,269	4,529	
	25th and 75th percentiles	5,132 – 9,880	2,758 – 6,955	
	Minimum and maximum	0 — 35,448	0 — 31,649	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	12.2 (5.8)	16.7 (10.6)	
	Median	11	14	
	25th and 75th percentiles	8 – 15	9 – 20	
	Minimum and maximum	4 — 56	4 — 82	
702	**Number of patient records**	**6,078**	**1,080**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	9,375 (5,031)	6,545 (4,058)	
	Median	8,600	5,928	
	25th and 75th percentiles	6,145 – 11,635	3,798 – 8,422	
	Minimum and maximum	0 — 50,803	0 — 31,352	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	9,674 (5,257)	6,487 (3,962)	
	Median	8,809	5,739	
	25th and 75th percentiles	6,282 – 12,030	3,812 – 8,315	
	Minimum and maximum	0 — 43,576	0 — 32,713	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	14.5 (6.6)	21.2 (12.6)	
	Median	14	19	
	25th and 75th percentiles	10 – 18	13 – 26	
	Minimum and maximum	4 — 65	4 — 99	

Table 4.32 (cont'd)

Case-Mix Group	Variable	IRF	SNF	P
703	**Number of patient records**	**3,964**	**730**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	10,837 (5,560)	7,073 (4,300)	
	Median	9,900	6,269	
	25th and 75th percentiles	7,199 – 13,625	4,160 – 9,431	
	Minimum and maximum	0 — 51,480	0 — 32,401	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	11,242 (5,947)	6,888 (4,095)	
	Median	10,127	6,035	
	25th and 75th percentiles	7,314 – 14,188	4,109 – 9,205	
	Minimum and maximum	0 — 47,547	0 — 26,937	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	16.3 (7.1)	23.2 (14.7)	
	Median	15	19	
	25th and 75th percentiles	11 – 20	14 – 29	
	Minimum and maximum	4 — 67	4 — 118	
704	**Number of patient records**	**3,316**	**650**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	11,895 (6,156)	8,030 (5,052)	
	Median	10,874	6,997	
	25th and 75th percentiles	7,788 – 14,930	4,738 – 10,513	
	Minimum and maximum	0 — 52,459	0 — 27,910	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	12,351 (6,566)	7,649 (4,900)	
	Median	11,236	6,562	
	25th and 75th percentiles	7,886 – 15,570	4,472 – 9,594	
	Minimum and maximum	0 — 56,664	0 — 28,980	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	17.8 (8.0)	25.2 (14.3)	
	Median	16	22	
	25th and 75th percentiles	13 – 22	15 – 32	
	Minimum and maximum	4 — 72	4 — 100	

Table 4.32 (cont'd)

Case-Mix Group	Variable	IRF	SNF	P
705	**Number of patient records**	**6,753**	**1,723**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	13,277 (7,175)	9,150 (6,378)	
	Median	12,019	7,491	
	25th and 75th percentiles	8,409 – 16,651	4,704 – 11,975	
	Minimum and maximum	0 — 66,128	0 — 37,785	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	13,897 (7,678)	8,762 (6,147)	
	Median	12,550	7,238	
	25th and 75th percentiles	8,741 – 17,377	4,583 – 11,286	
	Minimum and maximum	0 — 63,098	0 — 40,554	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	19.5 (9.3)	27.8 (17.5)	
	Median	18	23	
	25th and 75th percentiles	13 – 24	15 – 35	
	Minimum and maximum	4 — 73	4 — 124	

SD = standard deviation
Significance levels determined using Mann-Whitney *U* procedure.
Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education.

Results – 1996 Stroke Database

Application of Exclusion Criteria – 1996 Stroke Database

The records of 37,174 patients with stroke who had rehabilitation stays in 1996 were linked for this study. Application of the exclusion criteria resulted in the removal of 17.4 percent of IRF records and 33.3 percent of SNF records because these stays were considered atypical, or because FIM data were missing.

The number and percent of cases excluded for each criterion are reported in Table 4.51. As noted below the table, more than one criterion may have applied to one patient record.

The percent of patients excluded from the analyses varied by rehabilitation setting. A significantly higher percent of SNF records were excluded for the following reasons: 1) the patients' pre-stroke living setting was not community-based (2.2% for IRFs versus 4.3% for SNFs); 2) the patients' onset times were greater than 60 days (2.6% versus 3.9%); 3) the patients were admitted to the facility directly from another rehabilitation facility (3.9% versus 10.1%); 4) the patients were discharged to an acute care unit (6.0% versus 11.3%); 5) the patients died during the rehabilitation program (0.4% versus 4.3%); 6) the patients had a program interruption during the rehabilitation stay (3.5% versus

4.3%); and 7) patients' records were missing discharge FIM ratings (0.2% for IRFs versus 1.9% for SNFs).

The final sample for the 1996 stroke database was 30,345 records, of which 95.0 percent (n = 28,838) represented IRF stays, and 5.0 percent (n = 1,507) SNF stays.

Figures 4.5 and 4.6 provide a summary of the number of records received from CMS and UDSMR, the number of records that were linked, and the number of records remaining after the exclusion criteria was applied for IRFs (Figure 4.5) and SNFs (Figure 4.6) in the 1996 stroke database.

Patient Characteristics – 1996 Stroke Database

The sociodemographic, diagnostic and hospitalization characteristics of the patients treated in IRFs and SNFs are summarized in Table 4.52. The patients who received rehabilitation services in IRFs, when compared to patients who received care in SNFs, tended to be younger (median age was 76 for IRFs versus 79 for SNFs), were more likely to be non-white (16.2% versus 10.9%), were more likely to be currently married (48.7% versus 43.0%), and were less likely to have lived alone prior to the stroke (31.0% versus 36.5%).

Table 4.51 Number and Percent of Records of Patients with Stroke Excluded from Analyses for All Cases and by Rehabilitation Setting, 1996. (n = 37,174)

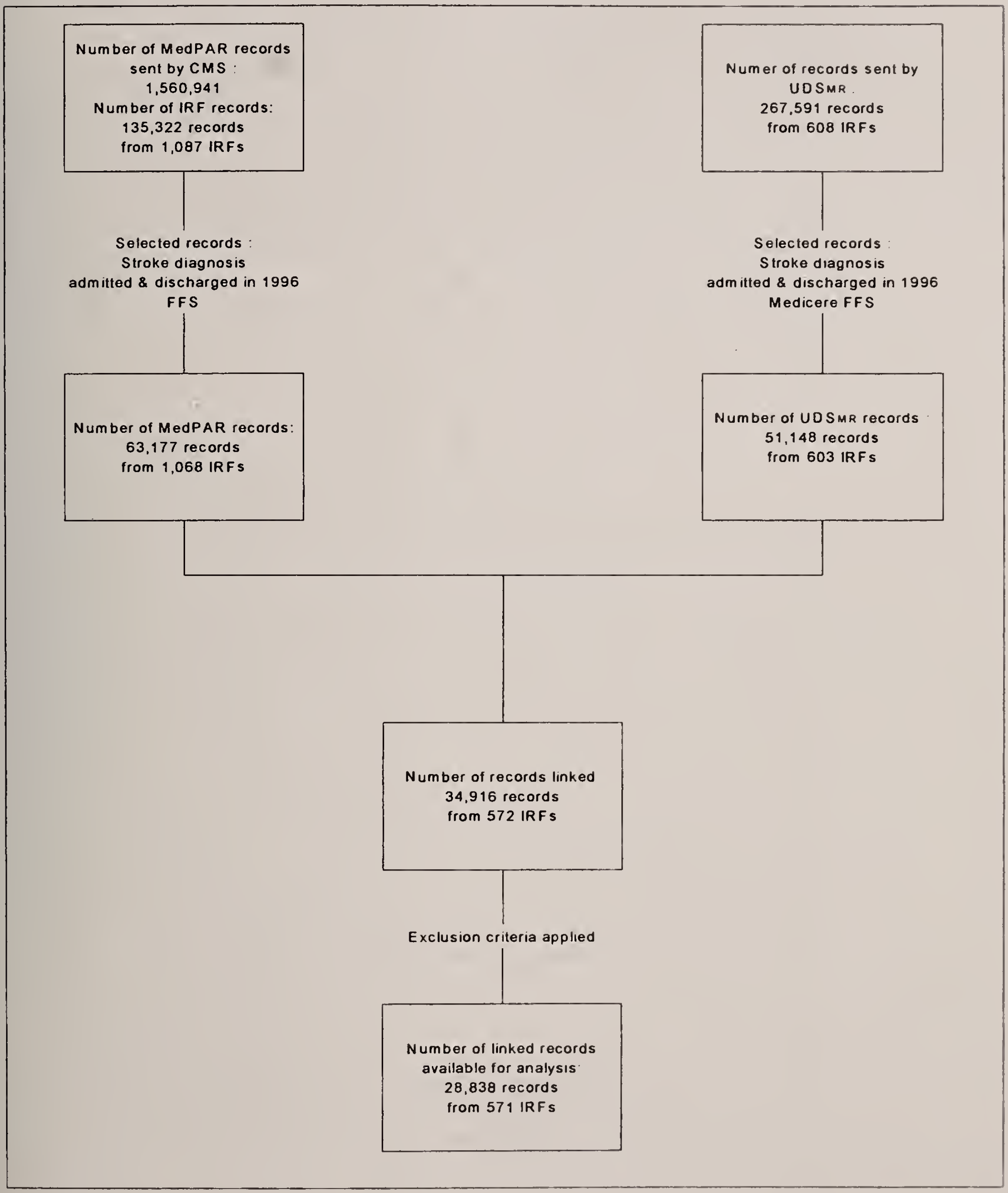
Exclusion Criteria		Inpatient Rehabilitation Facility (n =34,916)		Skilled Nursing Facility (n=2,258)		P
		n	%	n	%	
1	Patient's pre-stroke living setting was not community-based	760	2.2	98	4.3	< .001
2	The time between the patient's stroke and rehabilitation admission was greater than 60 days	907	2.6	87	3.9	< .001
3	Patient admitted to rehabilitation facility from another rehabilitation facility, a SNF, or a long-term care hospital	1,362	3.9	229	10.1	< .001
4	Patient was discharged from rehabilitation facility to an acute care facility	2,088	6.0	256	11.3	< .001
5	Patient died while in the rehabilitation facility	149	0.4	98	4.3	< .001
6	Patient's rehabilitation length of stay was 3 days or fewer	833	2.4	67	3.0	.081
7	Patient's length of stay was longer than mean plus 3 standard deviations of natural log of length of stay	19	0.1	2	0.1	.508
8	Patient had a program interruption during the rehabilitation stay	1,205	3.5	96	4.3	.045
9	Admission FIM data was missing from the patient's record	25	0.1	3	0.1	.304
10	Discharge FIM data was missing from the patient's record	67	0.2	42	1.9	< .001
Total number and percent of records excluded from analyses*		**6,078**	**17.4**	**751**	**33.3**	< .001
Total number and percent of records included in analyses*		**28,838**	**82.6**	**1,507**	**66.7**	

* More than one exclusion criterion may apply to an individual patient, thus, n and % columns do not add up to the total number of excluded records

SNF = Skilled Nursing Facility; FIM = Functional Independence Measure.

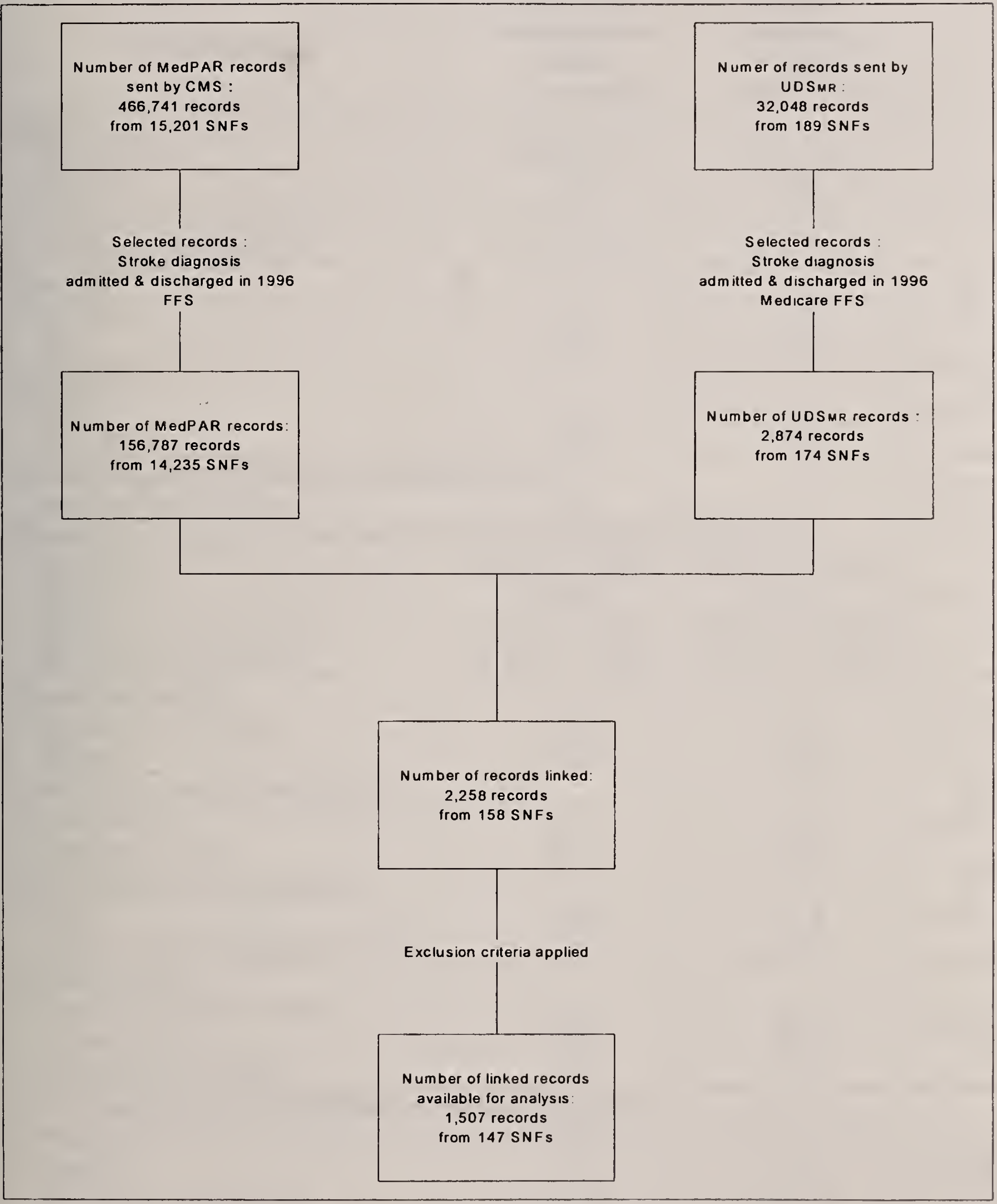
Significance levels determined using Chi-square test.

Figure 4.5 **Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Inpatient Rehabilitation Facilities, 1996 Stroke**


Number of MedPAR records sent by CMS : 1,560,941
Number of IRF records: 135,322 records from 1,087 IRFs
Numer of records sent by UDSMR . 267,591 records from 608 IRFs
Selected records : Stroke diagnosis admitted & discharged in 1996 FFS
Selected records : Stroke diagnosis admitted & discharged in 1996 Medicere FFS
Number of MedPAR records: 63,177 records from 1,068 IRFs
Number of UDSMR records 51,148 records from 603 IRFs
Number of records linked 34,916 records from 572 IRFs
Exclusion criteria applied
Number of linked records available for analysis 28,838 records from 571 IRFs

MedPAR refers to Medicare Payment and Review Record, CMS, Centers for Medicare and Medicaid Services; UDSMR, Uniform Data System for Medical Rehabilitation; IRF, Inpatient Rehabilitation Facility; FFS, fee-for-service

Figure 4.6 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Skilled Nursing Facilities, 1996 Stroke


Number of MedPAR records sent by CMS : 466,741 records from 15,201 SNFs
Numer of records sent by UDSMR : 32,048 records from 189 SNFs
Selected records : Stroke diagnosis admitted & discharged in 1996 FFS
Selected records : Stroke diagnosis admitted & discharged in 1996 Medicare FFS
Number of MedPAR records: 156,787 records from 14,235 SNFs
Number of UDSMR records : 2,874 records from 174 SNFs
Number of records linked: 2,258 records from 158 SNFs
Exclusion criteria applied
Number of linked records available for analysis: 1,507 records from 147 SNFs

MedPAR refers to Medicare Payment and Review Record, CMS, Centers for Medicare and Medicaid Services; UDSMR, Uniform Data System for Medical Rehabilitation; SNF, Skilled Nursing Facility; FFS, fee-for-service

Table 4.52 Sociodemographic and Hospitalization Characteristics of Patients with Stroke by Rehabilitation Setting, 1996 (n = 30,345)

Characteristic	Inpatient Rehabilitation Facility (n=28,838)	Skilled Nursing Facility (n=1,507)	P
Age (yr)			<.001
Mean (SD)	75.9 (8.5)	78.4 (8.5)	
Median	76	79	
25th and 75th percentiles	71 – 82	73 – 84	
Minimum and Maximum	21 — 103	35 — 103	
Sex (%)			.044
Female	55.1	57.5	
Male	44.9	42.5	
Race (%)			<.001
White	83.8	89.1	
Non-white	16.2	10.9	
Dually eligible for Medicare and Medicaid (%)			.075
Medicare and Medicaid	10.1	8.8	
Median household income based on ZIP code (1993 US Dollars)			<.001
Mean (SD)	33,167 (12,922)	35,330 (12,281)	
Median	30,623	33,431	
25th and 75th percentiles	24,474 – 39,077	26,525 – 42,269	
Minimum and maximum	6,984 – 142,217	5,591 – 91,338	
Marital status (%)			<.001
Not currently married	51.3	57.0	
Married	48.7	43.0	
Lived alone prior to stroke (%)			<.001
Lived alone	31.0	36.5	
Lived with others	69.0	63.5	
Pre-hospital living setting (%)			.007
Home	98.2	97.3	
Board & Care, Transitional Living	1.8	2.7	
Admit from (%)			<.001
Community-based setting	4.5	2.3	
Acute care unit	93.9	96.5	
Alternate level of care	1.6	1.3	
Time from stroke to rehabilitation admission (days)			<.001
Mean (SD)	9.2 (8.1)	12.9 (11.6)	
Median	7	9	
25th and 75th percentiles	4 – 11	5 – 16	
Minimum and maximum	0 — 60	0 — 60	
Length of rehabilitation stay (days)			<.001
Mean (SD)	20.9 (11.7)	25.4 (18.0)	
Median	19	21	
25th and 75th percentiles	13 – 27	13 – 32	
Minimum and maximum	4 — 109	4 — 105	

Table 4.52 (cont'd)

Characteristic	IRF (n=28,838)	SNF (n=1,507)	P
Time from stroke to rehabilitation discharge (days)			<.001
Mean (SD)	30.1(15.1)	38.3 (23.2)	
Median	27	33	
25th and 75th percentiles	19 – 37	21 – 49	
Minimum and maximum	4 — 151	5 — 150	
Discharge setting (%)			<.001
Community	78.4	66.4	
Comorbidities/complications (%)			.148
Tier 1 (most serious)	0.5	0.5	
Tier 2 (moderately serious)	1.7	2.5	
Tier 3 (least serious)	8.8	9.1	
None of listed comorbidities	89.0	87.9	
Stroke etiology (%)			.050
Ischemia	89.6	91.2	
Hemorrhage	10.4	8.8	
Case-mix group distribution (%)			<.001
101 to 103 mild disability	7.6	8.8	
104 to 105 mild to moderate disability	25.5	24.2	
106 to 107 moderate disability	21.7	15.6	
108 to 109 moderate severe disability	11.9	8.4	
110 to 114 severe disability	33.4	43.1	
Admission motor FIM rating			<.001
Mean (SD)	41.9 (14.6)	38.9 (16.9)	
Median	43	39	
25th and 75th percentiles	31 – 52	24 – 51	
Minimum and maximum	13 — 91	13 — 91	
Admission cognitive FIM rating			<.001
Mean (SD)	22.6 (8.4)	21.5 (9.7)	
Median	24	22	
25th and 75th percentiles	16 – 30	13 – 30	
Minimum and maximum	5 — 35	5 — 35	
Discharge motor FIM rating			<.001
Mean (SD)	62.0 (17.9)	55.2 (22.1)	
Median	65	59	
25th and 75th percentiles	52 – 76	37 – 74	
Minimum and maximum	13 — 91	13 — 91	
Discharge cognitive FIM rating			<.001
Mean (SD)	26.0 (7.6)	24.2 (9.0)	
Median	28	26	
25th and 75th percentiles	21 – 32	18 – 32	
Minimum and maximum	5 — 35	5 — 35	

P refers to probability; yr, year; SD, standard deviation; ZIP, Zone Improvement Plan; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Significance levels determined using Mann-Whitney *U* (continuous variables) and Chi-square (categorical) tests.

Patient Characteristics – 1996 Stroke Database (cont'd)

Patients admitted to IRFs had slightly shorter onset times (median was 7 days for IRFs versus 9 days for SNFs) and slightly shorter rehabilitation stays (median was 19 days for IRFs and 21 days for SNFs.

The percent of patients discharged to community-based settings was significantly different for the 2 settings, with 78.4 percent of IRF patients returning to the community, and 66.4 percent of SNF patients returning to the community.

The case-mix distribution showed that IRFs admitted a lower percentage of patients in the mild disability (Case-Mix Groups 101 to 103) and severe disability (Case-Mix Groups 110 to 114) groups, and a higher percentage of patients from the middle groups (Case-Mix Groups 104 to 109).

Motor and cognitive FIM ratings on admission and discharge were significantly higher for patients treated in IRFs. The median admission FIM rating was 43 for IRF patients, and 39 for SNF patients. Median admission cognitive FIM ratings for IRFs and SNFs were 24 and 22, respectively. By discharge, the difference between the median motor FIM ratings for IRFs and SNFs increased to 6 FIM units (65 for IRFs and 59 for SNFs). Median discharge cognitive ratings were 28 and 26, respectively.

Reliability of FIM Ratings – 1996 Stroke Database

Cronbach's alpha was calculated to assess the internal consistency of motor FIM and cognitive FIM ratings on admission and discharge for records in the 1996 stroke database. The results for the IRF and SNF patient records are reported in Table 4.53. All values were above 0.80, indicating good reliability.[109]

Table 4.53 Cronbach's Alpha for FIM Data, Patients with Stroke, 1996 (n = 30,345)

Rating Scale	Inpatient Rehabilitation Facility (n = 28,838)		Skilled Nursing Facility (n = 1,507)	
	Cronbach's Alpha	95% CI	Cronbach's Alpha	95% CI
Admission motor FIM ratings (13 items)	.926	.924 to .927	.939	.934 to 943
Admission cognitive FIM ratings (5 items)	.928	.927 to .930	.956	.953 to .960
Discharge motor FIM ratings (13 items)	.962	.962 to .963	.970	.967 to .972
Discharge cognitive FIM ratings (5 items)	.936	.935 to .937	.959	.956 to .963

FIM refers to Functional Independence Measure; CI, confidence interval

Facility-Level Market Characteristics – 1996 Stroke Database

The 1996 stroke database included data from 718 facilities, of which 571 (79.5%) were IRFs and 147 (20.5%) were SNFs. The characteristics of these facilities are reported in Table 4.54. Approximately 23 percent of the IRFs were freestanding facilities, whereas almost 60 percent of SNFs were freestanding facilities.

Table 4.54 Characteristics of Facilities by Rehabilitation Setting, Patients with Stroke, 1996 (n = 718 Facilities)

Characteristic	Inpatient Rehabilitation Facility (n=571)	Skilled Nursing Facility (n=147)	P
Type of facility (%)			< .001
Freestanding	22.8	59.9	
Distinct unit	77.1	40.2	
Rural status (%)			.190
Rural	9.6	6.1	
Geographic location*(%)			.110
New England	4.2	6.1	
Middle Atlantic	10.2	14.3	
East North Central	24.9	28.6	
West North Central	8.2	8.8	
South Atlantic	16.6	11.6	
East South Central	4.4	0.7	
West South Central	14.9	10.2	
Mountain	4.9	7.5	
Pacific	11.7	12.2	
Volume: number of patients (all payers)			< .001
Mean (SD)	133.7 (89.7)	31.5 (25.5)	
Median	112	24	
25th and 75th percentiles	70 – 177	14 – 42	
Minimum and maximum	6 — 527	1 — 158	
Managed care penetration in county (%)			.002
Mean (SD)	27.9 (17.0)	32.9 (16.4)	
Median	26.6	31.4	
25th and 75th percentiles	15.9 – 41.1	23.4 – 44.0	
Minimum and Maximum	0 — 74.8	0 — 74.5	
Patients in facility with managed care insurance (%)			.956
Mean (SD)	5.3 (7.4)	9.8 (15.4)	
Median	2.3	2.1	
25th and 75th percentiles	0 – 7.9	0 – 15.8	
Minimum and Maximum	0 — 53.0	0 — 83.0	
JCAHO accreditation (self-reported, %)			< .001
Yes	91.4	3.4	
No	8.6	96.6	
CARF accreditation (self-reported, %)			< .001
Yes	70.9	24.5	
No	29.1	75.5	
Number of operating beds			.025
Mean (SD)	34.1 (27.2)	28.1 (20.5)	
Median	25	24.5	
25th and 75th percentiles	17 – 41	15 – 34	
Minimum and Maximum	6 — 270	1 — 120	

Table 4.54 (cont'd)

Characteristic	IRF (n=571)	SNF (n=147)	P
Facility ownership			< .001
Government (Federal, state, county, local)	8.4	3.4	
Non-government, non-church-affiliated, not-for-profit	43.8	23.1	
Church-affiliated, non-government, not-for-profit	23.5	16.4	
Church-affiliated, for profit	1.1	0.0	
For profit, non-church-affiliated	15.6	54.4	
Other, unspecified	7.6	2.8	
Number of records in analysis			< .001
Mean (SD)	49.7 (41.3)	10.3 (10.2)	
Median	39	7	
25th and 75th percentiles	20 – 68	3 – 15	
Minimum and Maximum	1 — 267	1 — 72	

P refers to probability; SD, standard deviation; JCAHO, Joint Commission on Accreditation of Healthcare Organizations; CARF, Commission on Accreditation of Rehabilitation Facilities; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Significance levels determined using Mann-Whitney *U* (continuous variables) and Chi-square (categorical) tests.
* See Appendix A: Glossary of Terms for a list of the States included in each geographic region.

Facility-Level Market Characteristics – 1996 Stroke Database (cont'd)

IRFs were most commonly located in the East North Central region (24.9% of facilities), followed by the South Atlantic region (16.6%), and the West South Central region (14.9%). The most frequent geographic locations for SNFs were the East North Central region (28.6%), the Middle Atlantic region (14.3%), and the Pacific region (12.2%).

In 1996, IRFs treated a median of 112 patients with stroke (all payers) per facility, whereas the SNFs treated a median of 24 patients per facility. Managed care penetration was slightly lower in the counties where IRFs were located, but the

percent of patients with managed care insurance who were treated in the IRFs and SNFs was not statistically significantly different.

As with the other databases, accreditation was much more common for IRFs.

IRFs had a higher number of operating beds in the facility, with half of the IRFs reporting between 17 and 41 beds (25th to 75th percentile), and SNFs reporting 15 to 34 beds. In terms of ownership, 67.3 percent of the IRFs were not-for-profit entities (both church-affiliated and non-church-affiliated), whereas 54.4 percent of SNFs were for-profit entities.

The median number of records per facility used in the analyses was 39 for IRFs, and 7 for SNFs.

Research Question 4: Did the Percentage of Patients with Stroke Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1996?

Preparing Data for the Logistic Regression Analyses

Logistic regression was used to test whether the percentage of patients with stroke discharged to the community was different for IRFs and SNFs in 1996.

Covariates were entered into the regression model prior to the rehabilitation setting variable to control for differences in patient sociodemographic and medical history and facility factors prior to testing the impact of the rehabilitation setting.

The distribution of each continuous covariate was examined. If indicated, data were transformed based on the procedure (e.g., logarithm, square root) which best provided a normal distribution as evidenced by the lowest Kolmogorov-Smirnov statistic.

Correlations between each of the transformed covariates and the independent variable were reviewed. The strongest correlation was 0.488 between the transformed values of the admission motor FIM ratings and the admission cognitive FIM ratings.

The first series of regression models tested for effect-measure modifications. Using the cross-product terms, statistically significant interactions were found between 1) admission motor FIM ratings and the rehabilitation setting (p = .001); 2) age and rehabilitation setting (p = < .001); and 3) the 3-way interaction of admission motor FIM ratings, age and the rehabilitation setting (p = .010).

The cross-product term of living alone prior to stroke and rehabilitation setting was not significant (p = .146).

Based on these results, the 1996 stroke database was separated into 4 groups based on Case-Mix Group assignment and the median age of 77 years. These groups were: 1) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were 77 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were 78 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 77 years of age or younger, 4) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 78 years of age or older.

The distribution of each continuous covariate for each of the 4 groups was examined, and, if indicated, data were transformed. Correlations between each of the transformed covariates and the independent variable were calculated to assess for a potential problem with multicollinearity. The strongest correlations for the 4 groups were 0.373 for Group 1, 0.359 for Group 2, 0.437 for Group 3, and 0.514 for Group 4. In each group, these correlations were between the transformed value of the volume variable, and the rehabilitation setting variable.

The Percent of Patients Discharged to the Community from Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The percent of community-based discharges for each rehabilitation setting, without adjusting for covariates, was calculated prior to executing the regression

analyses, and results are presented in Table 4.55. For each of the 4 groups, the percent of patients discharged to the community was significantly higher for the IRFs. Differences ranged from 5.1 percent for the first group to 15.6 percent for the third group.

Table 4.55 Unadjusted Percent of Patients with Stroke Discharged to Community-Based Settings by Rehabilitation Setting, 1996 (n = 30,345)

	Group	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	**Mild to Moderate Disability & age ≤ 77 years**	93.6% (n= 9,008)	88.5% (n = 338)	< .001
2	**Mild to Moderate Disability & age ≥ 78 years**	87.0% (n = 6,781)	81.7% (n = 394)	.003
3	**Severe Disability & age ≤ 77 years**	69.0% (n = 7,131)	53.4% (n = 335)	< .001
4	**Severe Disability & age ≥ 78 years**	56.9% (n = 5,918)	45.7% (n = 440)	< .001

Significance levels determined using Chi-square test.

Logistic Regression Results for the 1996 Stroke Database

Results of the logistic regression analyses for the 4 case-mix/age groups are reported in tables 4.56, 4.57, 4.58, and 4.59.

As with the other regression analyses, coefficients for covariates are reported in these tables, but are not discussed. Some data were transformed, thus coefficients for some of these variables may be unstable.[112] The coefficients for covariates using untransformed data are reported and discussed in Appendix F (Tables F.17 to F.20).

Among patients younger than 78 years of age (Groups 1 and 3; Tables 4.56 and 4.58), rehabilitation care in an IRF was significantly (p < .001 and p = .001, respectively) associated with a higher likelihood of returning to a community-based setting, after controlling for covariates. For younger patients with mild to moderate disability (Group 1), the adjusted odds ratio was 2.19 (95% CI: 1.43 to 3.36), and for patients with severe disabilities who were younger than 78 years (Group 3), the adjusted odds ration was 1.62 (95% CI: 1.23 to 2.13).

For older patients with mild to moderate disabilities (Group 2; Table 4.43), the patients admitted to IRFs were perhaps more likely to return to the community. The odds ratio was 1.31, but the 95 percent confidence interval included 1.0 (95% CI: 0.96 to 1.80; p = .092)

For older patients with severe disabilities (Group 4; Table 4.45), no difference was found (p = .199) after adjusting for covariates.

Table 4.56 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 101 to 107 and 77 Years of Age or Younger, 1996 (n = 9,346)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	0.322	0.134	5.77	0.016	1.38	1.06	1.79
Admission motor FIM rating (*logarithm base 10*)	8.905	0.745	142.8	< .001	7366.5	1710.1	31732
Admission cognitive FIM rating (*cube*)	0.002	0.000	170.7	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	-0.258	0.133	3.74	0.053	0.77	0.59	1.00
Tier 1 comorbidity (present =1)	0.466	1.033	0.20	0.652	1.59	0.21	12.06
Tier 2 comorbidity (present =1)	-0.335	0.321	1.09	0.296	0.72	0.38	1.34
Tier 3 comorbidity (present =1)	-0.302	0.142	4.53	0.033	0.74	0.56	0.98
Age (*cube*)	0.000	0.000	22.76	< .001	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-1.330	0.091	214.0	< .001	0.26	0.22	0.32
Median household income (*logarithm base 10*)	-0.120	0.300	0.16	0.689	0.89	0.49	1.60
Sex (female =1)	-0.005	0.090	0.00	0.960	1.00	0.83	1.19
Race (white =1)	0.282	0.128	4.82	0.028	1.33	1.03	1.71
Volume of patients (*logarithm base 10*)	0.055	0.166	0.11	0.740	1.06	0.76	1.46
County managed care penetration (*no transformation*)	-0.411	0.273	2.27	0.132	0.66	0.39	1.13
Rehabilitation setting (IRF=1, SNF=0)	0.784	0.218	12.95	< .001	2.19	1.43	3.36
Constant	-12.50	1.868	44.74	< .001	0.00	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.57 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 101 to 107 and 78 Years of Age or Older, 1996 (n = 7,175)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	0.039	0.115	0.12	0.733	1.04	0.83	1.30
Admission motor FIM rating (*logarithm base 10*)	8.693	0.647	180.8	< .001	5961.2	1678.8	21167
Admission cognitive FIM rating (*cube*)	0.001	0.000	152.2	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	-0.248	0.120	4.24	0.039	0.78	0.62	0.99
Tier 1 comorbidity (present =1)	-0.919	0.712	1.67	0.197	0.40	0.10	1.61
Tier 2 comorbidity (present =1)	0.172	0.353	0.24	0.627	1.19	0.59	2.37
Tier 3 comorbidity (present =1)	0.156	0.161	0.95	0.331	1.17	0.85	1.60
Age (*logarithm base 10*)	-9.847	1.671	34.75	< .001	0.00	0.00	0.00
Pre-hospital living alone (alone =1)	-0.850	0.077	121.7	< .001	0.43	0.37	0.50
Median household income (*logarithm base 10*)	-0.182	0.261	0.49	0.485	0.83	0.50	1.39
Sex (female =1)	-0.115	0.080	2.06	0.151	0.89	0.76	1.04
Race (white =1)	0.472	0.152	9.65	0.002	1.60	1.19	2.16
Volume of patients (*square* root)	0.012	0.010	1.40	0.236	1.01	0.99	1.03
County managed care penetration (*no transformation*)	0.402	0.235	2.92	0.087	1.50	0.94	2.37
Rehabilitation setting (IRF=1, SNF=0)	0.272	0.161	2.85	0.092	1.31	0.96	1.80
Constant	5.845	3.589	2.65	0.103	345.39	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.58 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stoke in Case-Mix Groups 108 to 114 and 77 Years Old or Younger, 1996 (n = 7,466)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time (*logarithm base 10*)	-0.098	0.080	1.51	0.219	0.91	0.77	1.06
Admission motor FIM rating (*square*)	0.001	0.000	399.1	< .001	1.00	1.00	1.00
Admission cognitive FIM rating (*cube*)	0.001	0.000	53.21	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	0.093	0.081	1.30	0.255	1.10	0.94	1.29
Tier 1 comorbidity (present =1)	-0.118	0.270	0.19	0.663	0.89	0.52	1.51
Tier 2 comorbidity (present =1)	-0.250	0.165	2.31	0.128	0.78	0.56	1.07
Tier 3 comorbidity (present =1)	-0.215	0.082	6.83	0.009	0.81	0.69	0.95
Age (*cube*)	0.000	0.000	19.60	< .001	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-0.956	0.062	233.9	< .001	0.38	0.34	0.43
Median household income (*logarithm base 10*)	-0.506	0.180	7.91	0.005	0.60	0.42	0.86
Sex (female =1)	0.001	0.055	0.00	0.987	1.00	0.90	1.11
Race (white =1)	0.283	0.071	16.02	< .001	1.33	1.16	1.52
Volume of patients (*logarithm base 10*)	-0.085	0.104	0.66	0.416	0.92	0.75	1.13
County managed care penetration (*no transformation*)	-0.247	0.169	2.15	0.143	0.78	0.56	1.09
Rehabilitation setting (IRF=1, SNF=0)	0.483	0.141	11.77	0.001	1.62	1.23	2.13
Constant	2.241	0.830	7.30	0.007	9.41	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.59 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 78 Years of Age or Older, 1996 (n = 6,358)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	0.027	0.080	0.12	0.734	1.03	0.88	1.20
Admission motor FIM rating (*square*)	0.001	0.000	300.6	< .001	1.00	1.00	1.00
Admission cognitive FIM rating (*cube*)	0.001	0.000	39.27	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	-0.165	0.091	3.26	0.071	0.85	0.71	1.01
Tier 1 comorbidity (present =1)	-0.051	0.370	0.02	0.891	0.95	0.46	1.96
Tier 2 comorbidity (present =1)	-0.333	0.197	2.88	0.090	0.72	0.49	1.05
Tier 3 comorbidity (present =1)	-0.206	0.097	4.52	0.033	0.81	0.67	0.98
Age (*logarithm base 10*)	-3.707	1.252	8.77	0.003	0.02	0.00	0.29
Pre-hospital living alone (alone =1)	-0.789	0.059	176.0	< .001	0.45	0.40	0.51
Median household income (*logarithm base 10*)	-0.584	0.185	9.96	0.002	0.56	0.39	0.80
Sex (female =1)	0.006	0.058	0.01	0.919	1.01	0.90	1.13
Race (white =1)	0.835	0.090	86.75	< .001	2.30	1.93	2.75
Volume of patients (*logarithm base 10*)	-0.011	0.103	0.01	0.911	0.99	0.81	1.21
County managed care penetration (no transformation)	0.183	0.170	1.16	0.282	1.20	0.86	1.68
Rehabilitation setting (IRF=1, SNF=0)	0.162	0.126	1.65	0.199	1.18	0.92	1.51
Constant	8.750	2.562	11.67	0.001	6308.0	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Transformations made to covariates are reported after the variable name in parentheses.

Post-Hoc Power Analyses for Logistic Regression Results -- 1996 Stroke Database

The estimated power for each logistic regression analysis was calculated post-hoc to assist with the interpretation of the results. As shown in Table 4.60, the estimated power for these analyses, with an alpha of 0.05 and differences of 5 percent considered clinically important, was 93 percent for Group 1, 80 percent for Group 2, 45 percent for the third group, and 52 percent for the last group.

Although the estimated power for the third group was low, a statistically significant effect of the independent variable was detected in the logistic regression analysis. For the fourth group, the p value for the rehabilitation setting variable was calculated to be 0.199. Statistical power remained below 80 percent when alpha was increased to .20.

Table 4.60 Post-Hoc Power Estimates for Logistic Regression Analyses, 1996 Stroke Database (n = 30,345)

Group		IRF n	SNF n	Community Discharge – Percent		Alpha	Estimated power
				low	high		
1	**Mild to Moderate Disability & age ≤ 77 years**	9,008	338	88	93	.05	.93
2	**Mild to Moderate Disability & age ≥ 78 years**	6,781	394	82	87	.05	.80
						.10	.88
3	**Severe Disability & age ≤ 77 years**	7,131	335	58	63	.05	.45
4	**Severe Disability & age ≥ 78 years**	5,918	440	48	53	.05	.52
						.20	.77

IRF refers to Inpatient Rehabilitation Facility, and SNF refers to Skilled Nursing Facility

Assessment of Bias in Logistic Regression Results Due to Methodology – 1996 Stroke Database

As reported in the methods section, a median of 80.8 percent of IRF records and 83.3 percent of SNF records were linked with MedPAR records to create the 1996 stroke database. To determine whether the study methodology, including the procedures used to link the data, resulted in biased regression estimates, analyses of the UDSMR data for all Medicare fee-for-service patients with stroke were conducted. Results using the UDSMR data and results using the linked UDSMR/MedPAR data were compared.

The regression estimates, reported in Appendix G (Table G.5), showed that the odds ratios for corresponding groups were similar (i.e., within ± 15%) for 3 of the 4 groups. For Group 1, the odds ratio for the UDSMR data was estimated to be 1.55, and the estimate for the linked data was 2.19. For this group, the linked data resulted in an estimate that was directed away from the null of 1.0.

In the 1996 stroke database, 17.4 percent of IRF records and 33.3 percent of SNF records were excluded from analyses because they were considered "atypical" stays or because FIM data were missing. To determine whether an alternative set of exclusion criteria would have led to different results, additional analyses of the UDSMR/MedPAR linked data were run with 2 alternative exclusion criteria. Results using the Original Study Exclusion Criteria (i.e.,

excluding “atypical” stays), and results of the 2 alternative exclusion criteria were compared.

The first set of alternative exclusion criteria, referred to as Exclusion Criteria A, was the same as the Original Study Exclusion Criteria, except that it included the records of patients who had program interruptions, patients who died and patients who were discharged to acute care units. For the Exclusion Criteria A analyses, patients who died were coded as having a non-community discharge.

The second set of alternative exclusion criteria, Exclusion Criteria B, was the same as the Original Study Exclusion Criteria, with the additional exclusion of patients younger than 65 years, persons with long-term disability or renal failure.

Results of the logistic regression analyses using the Original Study Exclusion Criteria (reported in Tables 4.54, 4.55, 4.56 and 4.57) and results using Exclusion Criteria A and Exclusion Criteria B are shown in Appendix H (Table H.5).

A comparison of the odds ratios using Exclusion Criteria A and the odds ratio using the Original Study Exclusion Criteria showed that estimates were similar for 3 of the 4 groups. For Group 1, the estimated odds ratios were 1.79 for Exclusion Criteria A, and 2.19 for the Original Study Exclusion Criteria. The Study Exclusion Criteria estimate was directed away from the null of 1.00.

The comparison of the odds ratios using exclusion criteria B and the Original Study Exclusion Criteria also showed that the estimate for Group 1 was higher, and directed away from the null. For Group 3, the estimated odds ratios were similar (i.e., within ± 15%).

Summary of Logistic Regression Results -- 1996 Stroke Database

In summary, the logistic regression analyses of the 1996 stroke database found that patients younger than 78 years who were admitted to IRFs were more likely to return to the community than those admitted to SNFs. The regression analyses found that this difference was most pronounced for patients in Case-Mix Groups 101 to 107; these patients were more than twice as likely to return to the community. Analyses to determine whether the results may be biased found that this estimate may have been high.

Older patients in Case-Mix Groups 101 to 107 were probably more likely to return to the community; the p value showed borderline significance.

Analyses of the records of older patients in Case-Mix Groups 108 to 114 had low power – 52 percent. The p value for this analysis was .199; statistical power associated with this analysis with the alpha value set at .20 was calculated as 77 percent.

Research Question 5: Did the Functional Outcomes of Patients with Stroke Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1996?

Preparation of Data for Multiple Linear Regression Analyses

The multiple linear regression procedure was used to test whether the discharge motor function status of patients with stroke was different if the patient received rehabilitation services in an IRF or a SNF. As with all regression analyses used in this study, the 14 covariates were entered into the regression model prior to the rehabilitation setting variable to control for differences in patient sociodemographic and clinical factors and facility-level market factors.

The distribution of each continuous covariate was examined. If indicated, data were transformed based on the procedure (e.g., logarithm, square root) which best provided a normal distribution as evidenced by the lowest Kolmogorov-Smirnov statistic. The distribution of the discharge FIM ratings, the dependent variable, showed a slight negative skew, but not severe enough to warrant transformation.

Correlations between each of the transformed covariates and the independent variable were reviewed to assess for the potential of multicollinearity. All correlations were weaker than 0.5.

Testing of the research question began by using ANCOVA to assess for the presence of effect-measure modifications. To gauge the importance of any interactions, eta^2 was calculated. Statistically significant interactions were found between: 1) admission motor FIM ratings and the rehabilitation setting ($eta^2 = .001$), 2) age and rehabilitation setting ($eta^2 = <.001$), and 3) admission motor FIM ratings, age and the rehabilitation setting ($eta^2 = .008$).

The interaction of living alone prior to condition onset and rehabilitation setting was not significant ($p = .652$).

Based on the presence of effect-measure modifications related to the rehabilitation setting, admission motor functional status and age, the 1996 stroke database was stratified into 4 groups based on Case-Mix Group assignment and the median age of 77 years for further analyses. The groups were: 1) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were 77 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were 78 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 77 years of age or younger, 4) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 78 years of age or older.

Once data were stratified into the 4 case-mix/age groups, the distribution of each continuous covariate was assessed, and, if appropriate, data were transformed.

The strongest correlation, 0.514, was found in Group 4 between the transformed value of the volume variable, and the rehabilitation setting variable.

The Discharge Motor FIM Ratings of Patients Treated in Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The unadjusted mean, standard deviation and median discharge motor FIM ratings for each of the 4 groups were examined prior to executing the regression analyses. Results, reported in Table 4.61, show that statistically significantly different motor FIM ratings were detected for older patients with mild to moderate disabilities and all patients with severe disabilities (Group 2, Group 3 and Group 4). The mean IRF ratings were higher by 1.4, 9.5 and 8.9 FIM units, respectively.

Table 4.61 Unadjusted Mean, Standard Deviation, and Median Discharge Motor FIM Ratings of Patients with Stroke by Group, 1996 (n = 30,345).

Group		**Description**	**Inpatient Rehabilitation Facility**	**Skilled Nursing Facility**	**P**
1	**Mild to moderate disability & 77 years of age or younger**	Number	9,008	338	.227
		Mean (SD)	73.6 (9.7)	73.9 (10.6)	
		Median	75	76	
2	**Mild to moderate disability & 78 years of age or older**	Number	6,781	394	.009
		Mean (SD)	71.6 (10.1)	70.2 (10.8)	
		Median	72	70	
3	**Severe disability & 77 years of age or younger**	Number	7,131	335	< .001
		Mean (SD)	50.7 (16.5)	41.2 (17.6)	
		Median	53	41	
4	**Severe disability & 78 years of age or older**	Number	5,918	440	< .001
		Mean (SD)	46.8 (16.6)	37.9 (17.9)	
		Median	48	35	

FIM = Functional Independence Measure; P = probability; SD = standard deviation
Significance levels determined using Mann-Whitney *U* procedure.

Multiple Linear Regression Results for the 1996 Stroke Database

Results of the multiple linear regression analyses for the 4 case-mix/age groups are reported in Tables 4.62, 4.63, 4.64, and 4.65. Coefficients for the covariates are reported, but are not discussed, because some coefficients may be unstable due to power transformations.[112] The results for covariates using untransformed data are shown and discussed in Appendix F (Tables F.25 to F.28).

For the patients with mild to moderate disability who were 77 years of age or younger (Group 1; Table 4.62) a statistically significant effect of 1.73 was found ($p < .001$; R^2 change = .001). For the patients with mild to moderate disability who were 78 years of age or older (Group 2; Table 4.63) a statistically significant effect of 1.16 was detected ($p = .011$; R^2 change = .001), after controlling for covariates. Thus, after adjusting for covariates, patients with stroke discharged from IRFs achieved a higher discharge FIM rating of approximately 1.7 and 1.2 units. These differences, less than 2 FIM units, may not be clinically important.

For the patients in the third and fourth groups, who had severe disabilities (Tables 4.64 and 4.65), the rehabilitation setting also showed statistically significant effects. The younger patients with severe disabilities had a mean difference in motor FIM rating of approximately 6.0 FIM units ($p = <.001$; R^2 change = .004). Patients with severe disabilities who were older than 77 years of age experienced a mean difference in motor FIM rating of approximately 3.7 FIM units ($p = <.001$; R^2 change = .002).

Table 4.62 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger, 1996 Stroke Database (n = 9,346)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	-55.07	3.28	--	-16.81	< .001	-61.50	-48.65
Onset time (*logarithm base 10*)	-1.57	0.26	-0.05	-6.07	< .001	-2.07	-1.06
Admission motor FIM rating (*logarithm base 10*)	73.98	1.19	0.53	62.01	< .001	71.64	76.32
Admission cognitive FIM rating (*cube*)	0.00	0.00	0.14	16.39	< .001	0.00	0.00
Type of stroke (hemorrhage = 1)	0.74	0.27	0.02	2.71	0.007	0.21	1.28
Tier 1 comorbidity (present =1)	-0.23	1.28	0.00	-0.18	0.856	-2.74	2.28
Tier 2 comorbidity (present =1)	-0.91	0.67	-0.01	-1.35	0.176	-2.23	0.41
Tier 3 comorbidity (present =1)	-1.25	0.29	-0.04	-4.35	< .001	-1.82	-0.69
Age (*cube*)	0.00	0.00	-0.03	-3.75	< .001	0.00	0.00
Pre-hospital living alone (alone =1)	1.15	0.19	0.05	6.21	< .001	0.79	1.51
Median household income (*logarithm base 10*)	0.18	0.56	0.00	0.33	0.742	-0.91	1.27
Sex (female = 1)	-0.26	0.17	-0.01	-1.59	0.112	-0.59	0.06
Race (white = 1)	-0.95	0.22	-0.04	-4.27	< .001	-1.39	-0.52
Volume of patients (*logarithm base 10*)	-0.68	0.31	-0.02	-2.22	0.027	-1.29	-0.08
County managed care penetration (*no transformation*)	0.89	0.51	0.02	1.73	0.084	-0.12	1.90
Rehabilitation setting (IRF = 1, SNF = 0)	1.73	0.48	0.03	3.61	< .001	0.79	2.67

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.63 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older, 1996 Stroke Database (n = 7,175)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	-5.15	9.77	--	-0.53	0.598	-24.30	13.99
Onset time (*logarithm base 10*)	-2.00	0.30	-0.06	-6.61	< .001	-2.59	-1.41
Admission motor FIM rating (*logarithm base 10*)	79.09	1.48	0.51	53.61	< .001	76.20	81.99
Admission cognitive FIM rating (*cube*)	0.01	0.00	0.19	19.44	< .001	0.01	0.01
Type of stroke (hemorrhage = 1)	-0.37	0.34	-0.01	-1.09	0.275	-1.03	0.29
Tier 1 comorbidity (present =1)	-0.34	2.24	0.00	-0.15	0.881	-4.73	4.06
Tier 2 comorbidity (present =1)	-0.76	0.88	-0.01	-0.86	0.388	-2.49	0.97
Tier 3 comorbidity (present =1)	-1.07	0.41	-0.02	-2.64	0.008	-1.87	-0.27
Age (*logarithm base 10*)	-36.15	4.58	-0.08	-7.89	< .001	-45.13	-27.17
Pre-hospital living alone (alone =1)	1.45	0.20	0.07	7.12	< .001	1.05	1.84
Median household income (*logarithm base 10*)	1.59	0.67	0.02	2.38	0.017	0.28	2.89
Sex (female = 1)	-0.54	0.20	-0.03	-2.66	0.008	-0.94	-0.14
Race (white = 1)	-0.54	0.35	-0.02	-1.57	0.116	-1.22	0.13
Volume of patients (*square root*)	-0.02	0.03	-0.01	-0.77	0.440	-0.07	0.03
County managed care penetration (*no transformation*)	0.13	0.61	0.00	0.21	0.832	-1.07	1.33
Rehabilitation setting (IRF = 1, SNF = 0)	1.16	0.46	0.03	2.55	0.011	0.27	2.06

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.64 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger, 1996 Stroke Database (n = 7,466)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	22.93	4.57	--	5.01	< .001	13.96	31.89
Onset time (*logarithm base 10*)	-1.86	0.44	-0.04	-4.22	< .001	-2.72	-0.99
Admission motor FIM rating (*square*)	0.02	0.00	0.57	58.26	< .001	0.02	0.02
Admission cognitive FIM rating (*cube*)	0.01	0.00	0.12	12.27	< .001	0.01	0.01
Type of stroke (hemorrhage = 1)	3.67	0.45	0.07	8.10	< .001	2.78	4.55
Tier 1 comorbidity (present =1)	2.47	1.58	0.01	1.56	0.118	-0.63	5.58
Tier 2 comorbidity (present =1)	-2.71	0.94	-0.03	-2.87	0.004	-4.56	-0.86
Tier 3 comorbidity (present =1)	-1.68	0.46	-0.03	-3.63	< .001	-2.59	-0.77
Age (*cube*)	0.00	0.00	-0.05	-5.23	< .001	0.00	0.00
Pre-hospital living alone (alone =1)	0.39	0.36	0.01	1.09	0.274	-0.31	1.09
Median household income (*logarithm base 10*)	1.96	0.99	0.02	1.98	0.048	0.02	3.90
Sex (female = 1)	-1.16	0.30	-0.03	-3.84	< .001	-1.75	-0.57
Race (white = 1)	-1.52	0.38	-0.04	-4.04	< .001	-2.26	-0.79
Volume of patients (*logarithm base 10*)	-1.19	0.57	-0.02	-2.08	0.037	-2.32	-0.07
County managed care penetration (*no transformation*)	-0.94	0.93	-0.01	-1.01	0.312	-2.77	0.88
Rehabilitation setting (IRF = 1, SNF = 0)	6.03	0.81	0.07	7.43	< .001	4.44	7.62

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.65 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older, 1996 Stroke Database (n = 6,358)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	125.52	14.19	--	8.85	< .001	97.71	153.34
Onset time (*logarithm base 10*)	-1.63	0.44	-0.03	-3.67	< .001	-2.50	-0.76
Admission motor FIM rating (*square*)	0.02	0.00	0.61	62.05	< .001	0.02	0.02
Admission cognitive FIM rating (*cube*)	0.01	0.00	0.15	15.53	< .001	0.01	0.01
Type of stroke (hemorrhage = 1)	1.60	0.51	0.03	3.13	0.002	0.60	2.59
Tier 1 comorbidity (present =1)	0.11	2.09	0.00	0.05	0.957	-3.98	4.21
Tier 2 comorbidity (present =1)	-0.70	1.08	-0.01	-0.65	0.518	-2.82	1.42
Tier 3 comorbidity (present =1)	-1.04	0.54	-0.02	-1.94	0.053	-2.09	0.01
Age (*logarithm base 10*)	-54.38	6.94	-0.07	-7.84	< .001	-67.98	-40.78
Pre-hospital living alone (alone =1)	1.08	0.33	0.03	3.27	0.001	0.43	1.72
Median household income (*logarithm base 10*)	0.35	1.02	0.00	0.34	0.732	-1.65	2.35
Sex (female = 1)	-1.55	0.32	-0.05	-4.88	< .001	-2.18	-0.93
Race (white = 1)	-1.21	0.46	-0.02	-2.62	0.009	-2.12	-0.31
Volume of patients (*logarithm base 10*)	-0.45	0.57	-0.01	-0.78	0.433	-1.56	0.67
County managed care penetration (*no transformation*)	-0.05	0.94	0.00	-0.05	0.956	-1.89	1.79
Rehabilitation setting (IRF = 1, SNF = 0)	3.65	0.70	0.06	5.20	< .001	2.27	5.02

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Multicollinearity did bot appear to be a concern; the highest variance inflation factor values within each model were 1.243 for Group 1, 1.216 for Group 2, 1.330 for Group 3 and 1.414 for the last group. These values are below the value of 4, which could indicate a potential problem.[113] Histograms of the standardized regression residuals for each model showed residuals were generally normally distributed, addressing the regression assumption of normality.

Post-Hoc Power Analyses for Multiple Regression Results – 1996 Stroke Database

The estimated power of each analysis was calculated post-hoc to support the interpretation of the results. As shown in Table 4.66, the power for these analyses with an alpha of 0.05 and small effect size (i.e., incremental R^2 of .005), was estimated as 99 percent for all 4 groups.

Table 4.66 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1996 Stroke Database (n = 30,345)

Group		Number of Patient Records	Adjusted R^2	Effect Size: Incremental R^2 Increase	Alpha	Estimated Power
1	**Mild to Moderate Disability & age ≤ 77 years**	9,346	.343	.005	.05	.99
2	**Mild to Moderate Disability & age ≥ 78 years**	7,175	.367	.005	.05	.99
3	**Severe Disability & age ≤ 77 years**	7,466	.414	.005	.05	.99
4	**Severe Disability & age ≥ 78 years**	6,358	.493	.005	.05	.99

R^2 refers to multiple coefficient of determination

Assessment for Bias in Multiple Linear Regression Results due to Methodology – 1996 Stroke Database

As reported in the methods section, approximately 80.8 percent of IRF records and 83.3 percent of SNF records were linked and included in the 1996 stroke database. To determine whether the study methodology, including the procedures used to link the data, resulted in biased regression estimates, analyses of all the UDSMR data for Medicare fee-for-service patients with stroke were conducted. Results using the UDSMR data and results using the linked UDSMR/MedPAR data were compared. The regression estimates are reported in Appendix G (Table G.6).

The regression coefficients for 3 of the 4 groups were similar. For Group 1, the coefficient was 0.77 for the UDSMR data, and 1.73 for the linked data. The coefficient for the linked data was directed away from the null (i.e., 0.00, which would indicate no difference).

In the 1996 stroke database, 17.4 percent of IRF records and 33.3 percent of SNF records were excluded from analyses because they were considered "atypical" stays or because FIM data were missing. To determine whether an alternative set of exclusion criteria would have led to different results, additional analyses of the UDSMR/MedPAR linked data were executed with 2 alternative exclusion criteria. Results using the Original Study Exclusion Criteria (i.e.,

excluding "atypical" stays, and results using the 2 alternative exclusion criteria were compared.

The first set of alternative exclusion criteria, referred to as Exclusion Criteria A, was the same as the Original Study Exclusion Criteria, except that it included the records of patients who had program interruptions, patients who died and patients who were discharged to acute care hospitals. For the Exclusion Criteria A analyses, patients who died, the discharge motor FIM ratings were coded as 13 (i.e., dependent in all motor activities).

The second set of alternative exclusion criteria, called Exclusion Criteria B, was the same as the Original Study Exclusion Criteria, with the additional exclusion of patients who were younger than 65.

Results of the multiple linear regression analyses using the Original Study Exclusion Criteria (as reported in Tables 4.62, 4.63, 4.64 and 4.65) and results using Exclusion Criteria A and Exclusion Criteria B are reported in Appendix H (Table H.6).

A comparison of results using Exclusion Criteria A and results using the Original Study Exclusion Criteria showed that the regression coefficients were similar (i.e., within ± 0.75 FIM units) across all 4 groups. The coefficients were also similar when Exclusion Criteria B and the Study Exclusion Criteria were applied.

Summary of Multiple Linear Regression Results – 1996 Stroke Database

The multiple linear regression analyses of the 1996 stroke database showed that for patients with stroke in Case-Mix Groups 101 to 107, statistically significant effects of 1.7 and 1.2 FIM units (for younger and older patients, respectively) were found. These differences are small, and it is unclear if these differences were clinically important.

Among the patients in Case-Mix Groups 108 to 114, those who were treated in IRFs had higher motor FIM ratings at discharge compared to patients who were treated in SNFs. The mean difference was about 6 FIM units for patients younger than 78, and 4 FIM points for patients older than 77.

Research Question 6: Did Medicare Payments for Patients with Stroke Treated in IRFs Differ from Medicare Payments for Patient Treated in SNF-Based Rehabilitation Care across all Case-Mix Groups in 1996?

Payments to Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) -- 1996 Stroke Database

In the 1996 stroke database, the unadjusted median Medicare Part A payment per patient was $12,281 for IRFs and $6,486 (both 1996 US Dollars) for SNF-based rehabilitation programs (Table 4.67).

When payment amounts were standardized to reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education, with the median payment per patient to IRFs as $12,632, and the median payment per patient to SNF-based rehabilitation programs as $6,368, a difference of $6,264. Median Medicare Part A payments to IRFs were almost double the median payments to SNFs.

The median payment amount received by the facility from Medicare Part A, other primary payers and patients combined, was $12,489 for each patient discharged from an IRF, and $6,945 for each patient discharged from a SNF-based rehabilitation program.

For some stays, patients were responsible for paying (either out-of-pocket or through a Medigap provider) a deductible, co-insurance or a blood deductible. For patients treated in IRFs, 82.4 percent of patients had no liability. For patients treated in SNFs, 52.4 percent had no liability.

The payment data described above and additional statistics are reported in Table 4.67.

Table 4.67 Medicare Part A Payment Data for Fee-for-Service Patients with Stroke by Rehabilitation Setting, 1996 (n = 30,345)

Type of Payment	Inpatient Rehabilitation Facility (n=28,838)	Skilled Nursing Facility (n=1,507)	P
Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
Mean (SD)	13,997 (8,753)	8,180 (6,443)	
Median	12,281	6,486	
25th and 75th percentiles	7,740 – 18,346	3,913 – 10,569	
Minimum and maximum	0 — 88,827	0 — 54,000	
Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
Mean (SD)	14,294 (8,935)	8,145 (6,625)	
Median	12,632	6,368	
25th and 75th percentiles	7,880 – 18,787	3,754 – 10,370	
Minimum and maximum	0 — 89,975	0 — 58,933	
Payments to facility* (1996 U.S. Dollars)			< .001
Mean (SD)	14,308 (8,949)	9,155 (7,530)	
Median	12,489	6,945	
25th and 75th percentiles	7,980 – 18,612	4,125 – 11,757	
Minimum and Maximum	0 — 94,043	0 — 61,176	
Patient liability (1996 U.S. Dollars)			< .001
Patients with liability (%)	82.4	52.4	
Mean (SD)	207 (787)	918 (1,467)	
Median	0	92	
25th and 75th percentiles	0 — 0	0 – 1,288	
Minimum and maximum	0 — 26,128	0 — 7,360	

USD = United States Dollar; SD = standard deviation; DRG = diagnosis-related group
Significance levels determined using Mann-Whitney *U* procedure.
Patient liability includes co-insurance and deductibles. Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education.
* Payments from Medicare Part A, other primary payers and patients; does not include payments from Medicare Part B.

Medicare Payments and Length of Stay Based on Case-Mix Group Assignment – 1996 Stroke Database

Payment data were analyzed separately for 5 groups of patient records split based on Case-Mix Group assignment. The unadjusted and standardized

Medicare Part A payments per patient remained significantly higher for IRFs across all 5 groups (Table 4.68).

The difference between the median standardized payment of IRFs and SNFs increased as disability increased. For Case-Mix Groups 101 to 103, the difference between the median IRF payment and the median SNF payment was $3,108; the median IRF payments were double the median payments to SNFs. The difference increased to $4,510 (95.71% higher than SNF payment) for Case-Mix Groups 104 and 105, $6,568 (105.5% higher than SNF payment) for Case-Mix Groups 106 and 107, $8,191 (119.4% higher than SNF payment) for Case-Mix Group 108 and 109, and $9,104 (112% higher than SNF payment) for Case-Mix Groups 110 to 114.

For Case-Mix Groups 101 to 103, patients' rehabilitation stays in the two rehabilitation settings showed borderline significance (median IRF stay was 9 days and median SNF stay was 11 days; p = .087). For patients in Case-Mix Group 104 and 105, the median LOS was 14 days for IRFs and 17 days for SNFs, a significant difference of 3 days (p < .001).

For Case-Mix Groups 106 and 107, the median stays for IRFs and SNFs were 19 and 21, a difference of 2 days (p = .002). The median LOS for both IRFs and SNFs was 22 days for patients in Case-Mix Groups 108 and 109 (p = .245). There was a significant difference of 2 days for patients in Case-Mix Groups 110

and 114 (p = .002); the median LOS was 25 for IRF patients and 27 for SNF patients.

Table 4.68 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Stroke by Case-Mix Group and by Rehabilitation Setting, 1996 (n = 30,345)

Case-Mix Group	Variable	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
101 to 103	**Number of patient records**	**2,192**	**133**	
	Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
	Mean (SD)	7,147 (4,546)	4,146 (3,172)	
	Median	6,077	3,120	
	25th and 75th percentiles	4,221 – 8,955	2,201 – 5,589	
	Minimum and maximum	0 — 41,424	0 — 22,486	
	Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
	Mean (SD)	7,283 (4,649)	4,059 (2,994)	
	Median	6,190	3,082	
	25th and 75th percentiles	4,296 – 9,033	2,146 – 5,398	
	Minimum and maximum	0 — 46,020	0 — 20,138	
	Rehabilitation length of stay (days)			.087
	Mean (SD)	11.0 (6.3)	13.2 (11.7)	
	Median	9	11	
	25th and 75th percentiles	7 – 14	6.5 – 15.5	
	Minimum and maximum	4 — 63	4 — 99	
104 and 105	**Number of patient records**	**7,340**	**364**	
	Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
	Mean (SD)	10,048 (5,652)	5,704 (3,775)	
	Median	9,000	4,800	
	25th and 75th percentiles	6,171 – 12,800	3,055 – 7,470	
	Minimum and maximum	0 — 52,569	0 — 24,609	
	Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
	Mean (SD)	10,283 (5,802)	5,692 (3,853)	
	Median	9,225	4,715	
	25th and 75th percentiles	6,296 – 13,108	3,005 – 7,388	
	Minimum and maximum	0 — 54,517	0 — 24,890	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	15.3 (7.5)	19.3 (12.7)	
	Median	14	17	
	25th and 75th percentiles	10 – 19	11 – 23	
	Minimum and maximum	4 — 72	4 — 105	

Table 4.68 (cont'd)

Case-Mix Group	Variable	IRF	SNF	P
106 and 107	**Number of patient records**	**6,257**	**235**	
	Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
	Mean (SD)	13,475 (7,058)	7,155 (4,039)	
	Median	12,492	6,486	
	25th and 75th percentiles	8,667 – 17,172	4,276 – 9,198	
	Minimum and maximum	0 — 57,995	0 — 21,545	
	Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
	Mean (SD)	13,738 (7,218)	7,111 (4,177)	
	Median	12,796	6,228	
	25th and 75th percentiles	8,859 – 17,507	4,081 – 9,335	
	Minimum and maximum	0 — 59,703	0 — 23,563	
	Rehabilitation length of stay (days)			.002
	Mean (SD)	20.0 (9.2)	24.1 (15.7)	
	Median	19	21	
	25th and 75th percentiles	14 – 25	14 – 29	
	Minimum and maximum	4 — 99	5 — 99	
108 and 109	**Number of patient records**	**3,424**	**126**	
	Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
	Mean (SD)	15,707 (8,066)	8,689 (6,365)	
	Median	14,724	7,271	
	25th and 75th percentiles	10,105 – 19,950	4,615 – 10,881	
	Minimum and maximum	0 — 55,665	0 — 44,860	
	Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
	Mean (SD)	16,021 (8,241)	8,479 (6,490)	
	Median	15,053	6,862	
	25th and 75th percentiles	10,328 – 20,505	4,347 – 10,799	
	Minimum and maximum	0 — 66,498	0 — 48,147	
	Rehabilitation length of stay (days)			.245
	Mean (SD)	23.5 (10.6)	27.2 (17.7)	
	Median	22	22	
	25th and 75th percentiles	16 – 29	15 – 33	
	Minimum and maximum	4 — 88	4 — 101	

Table 4.68 (cont'd)

Case-Mix Group	Variable	IRF	SNF	P
110 to 114	**Number of patient records**	**9,625**	**649**	
	Medicare Part A payment, unadjusted (1996 U.S. Dollars)			< .001
	Mean (SD)	18,299 (10,133)	10,666 (7,702)	
	Median	16,800	8,432	
	25th and 75th percentiles	11,200 – 23,717	5,334 – 14,135	
	Minimum and maximum	0 — 88,827	0 — 54,000	
	Medicare Part A payment, standardized (1996 U.S. Dollars)			< .001
	Mean (SD)	18,696 (10,321)	10,667 (7,991)	
	Median	17,230	8,126	
	25th and 75th percentiles	11,531 – 24,117	5,283 – 13,734	
	Minimum and maximum	0 — 89,975	0 — 58,933	
	Rehabilitation length of stay (days)			.002
	Mean (SD)	27.1 (13.2)	31.5 (20.0)	
	Median	25	27	
	25th and 75th percentiles	18 – 34	17 – 42	
	Minimum and maximum	4 — 109	4 — 100	

SD refers to standard deviation
Significance levels determined using Mann-Whitney *U* procedure.
Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education.

Summary of Medicare Payment Analyses – 1996 Stroke Database

Medicare Part A payments to IRFs were significantly higher than payments made to SNFs for patients with stroke in 1996. The difference between the median standardized payments remained when data were stratified into 5 groups, ranging from a difference of $3,108 for the first group to $9,104 for Case-Mix Groups 110 to 114. Although payments to IRFs were higher, the median rehabilitation LOS for patients in IRFs tended to be shorter than the stays for patients in SNFs when stratified by Case-Mix Group. The stays were significantly shorter for 3 of the 5 groups.

Results – 1997 Stroke Database

Application of Exclusion Criteria – 1997 Stroke Database

The records of 35,579 patients with stroke who had rehabilitation stays in 1997 were linked to include functional status and payment data. Application of the exclusion criteria removed 19.1 percent of the IRF records and 31.5 percent of the SNF records (Table 4.69).

The percent of patients excluded from analyses varied by setting. A significantly higher percentage of SNF records were excluded for the following reasons: 1) patients were admitted to the facility from another rehabilitation facility (3.7% for IRFs versus 11.6% for SNFs); 2) patients were discharged to an acute care unit (5.5% versus 8.5%); 3) patients died during the rehabilitation stay (0.5% versus 3.8%); 4) patients had a rehabilitation LOS of 3 days or fewer (2.3% versus 3.4%), and 5) patients had program interruptions (3.9% versus 4.7%).

A greater number of IRF records were excluded because patients' records were missing admission FIM data (2.3% for IRFs versus 0.3% for SNFs) and discharge FIM data (2.5% for IRFs and 1.9% for SNFs).

The final sample for the 1997 stroke database was 28,379 records, of which 91.9 percent (n = 26,076) represented IRF stays, and 8.1 percent (n = 2,303) were SNF stays.

Table 4.69 Number and Percent of Records of Patients with Stroke Not Included in Analyses by Exclusion Criteria for All Cases and by Rehabilitation Setting, 1997 (n = 35,579)

Exclusion Criteria		Inpatient Rehabilitation Facility (n =32,219)		Skilled Nursing Facility (n=3,360)		P
		n	%	n	%	
1	Patient's pre-stroke living setting was not community-based	1,270	3.9	110	3.3	.056
2	The time between the patient's stroke and rehabilitation admission was greater than 60 days	841	2.6	97	2.9	.341
3	Patient admitted to rehabilitation facility from another rehabilitation facility, a SNF, or long-term care hospital	1,182	3.7	389	11.6	< .001
4	Patient was discharged from rehabilitation facility to an acute care facility	1,758	5.5	286	8.5	< .001
5	Patient died while in the rehabilitation facility	149	0.5	129	3.8	< .001
6	Patient's rehabilitation length of stay was 3 days or fewer	756	2.3	114	3.4	< .001
7	Patient's length of stay was longer than mean plus 3 standard deviations of natural log of length of stay	25	0.1	0	0.0	.106
8	Patient had a program interruption during the rehabilitation stay	1,251	3.9	159	4.7	.016
9	Admission FIM data was missing from the patient's record	752	2.3	10	0.3	< .001
10	Discharge FIM data was missing from the patient's record	800	2.5	65	1.9	.049
Total number and percent of records excluded from analyses*		**6,143**	**19.1**	**1,057**	**31.5**	< .001
Total number and percent of records included in analyses		**26,076**	**80.9**	**2,303**	**68.5**	

* More than one exclusion criterion may apply to an individual patient, thus, n and % columns do not add up to the total number of excluded records

SNF = Skilled Nursing Facility; FIM = Functional Independence Measure.

Significance levels determined using Chi-square test.

Figures 4.7 and 4.8 provide a summary of the number of records received from CMS and UDSMR, the number of records that were linked, and the number of records remaining after the exclusion criteria was applied for IRFs (Figure 4.7) and SNFs (Figure 4.8) in the 1997 stroke database.

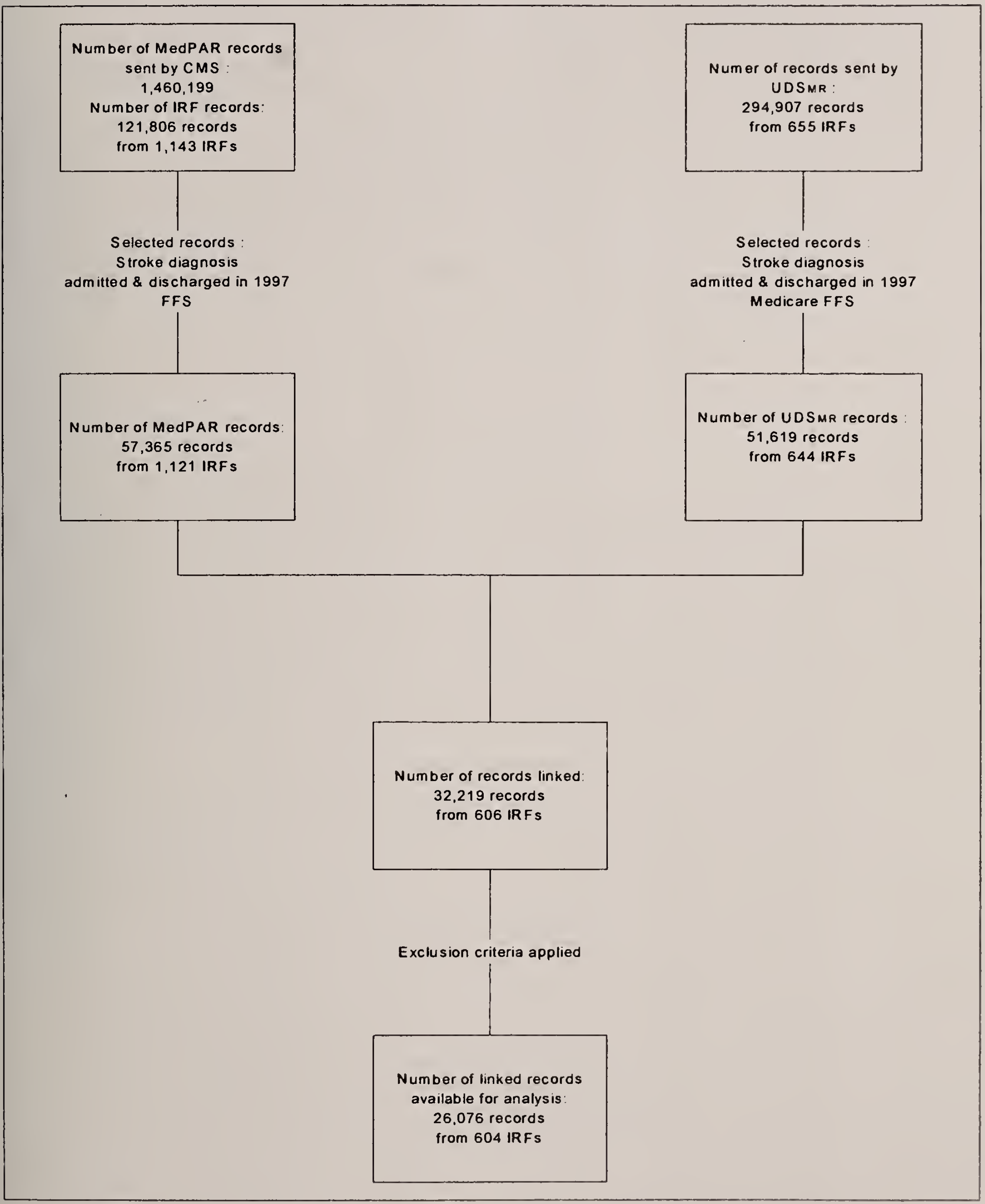
Patient Characteristics – 1997 Stroke Database

Table 4.70 reports that patients discharged from IRFs, when compared to patients discharged from SNFs, tended to be younger (median age for IRFs was 77 versus 80 for SNFs), were more likely to be male (44.6% versus 39.0%), were more likely to be non-white (16.5% versus 10.3%), were more likely to be on Medicaid (10.1% versus 7.1%), were more likely to be married (47.8% versus 39.0%), and were less likely to live alone (32.1% versus 36.4%).

Patients admitted to IRFs had a slightly shorter number of days between the stroke onset and the rehabilitation admission (median for IRFs was 6 days versus 7 days for SNFs). The rehabilitation stays in IRFs were also shorter than the stays in SNFs (medians were 18 and 20 days, respectively).

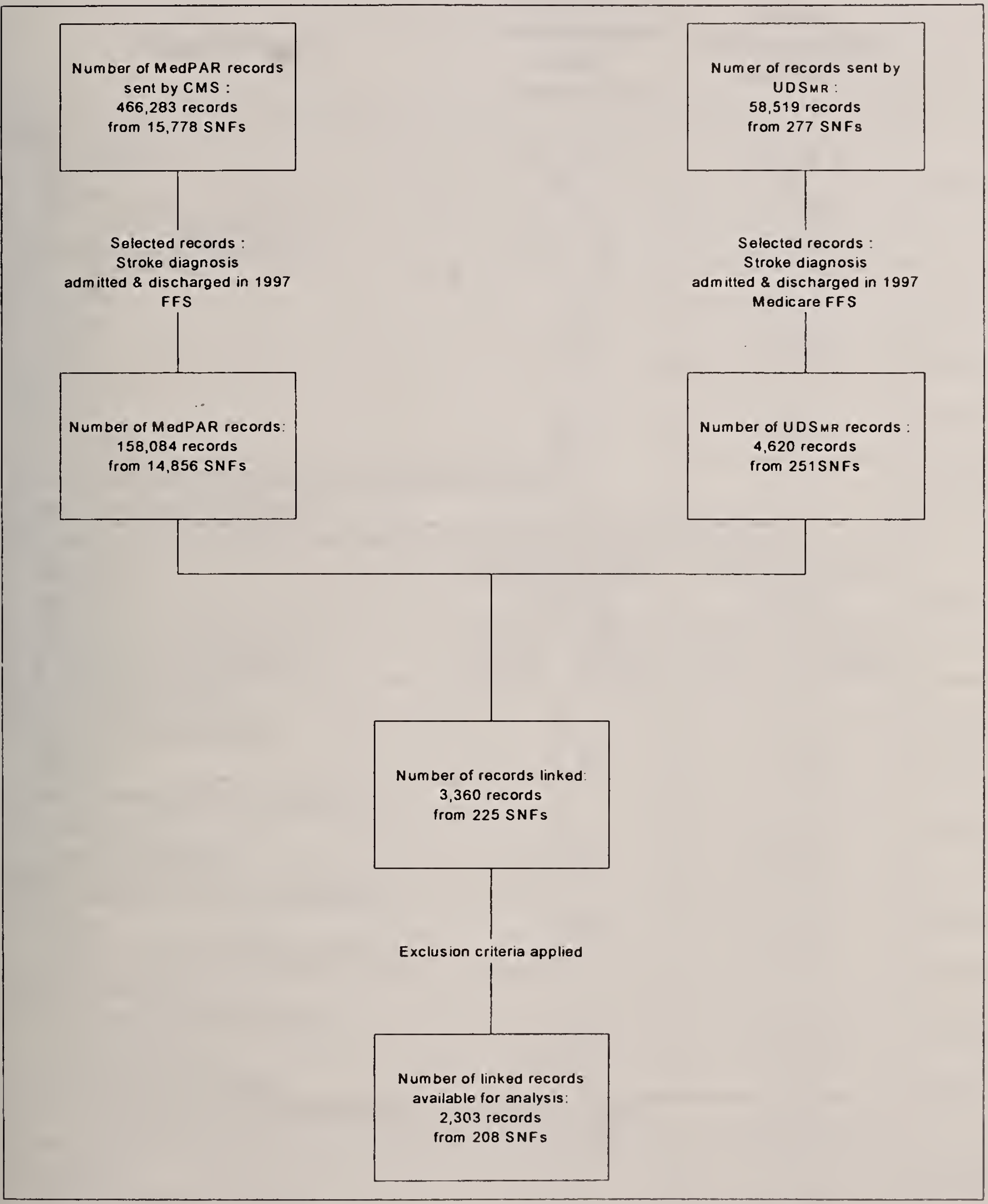
The percent of patients discharged to the community from IRFs was 78.1 percent, significantly higher than the 69.5 percent who were discharged to the community from SNFs.

Figure 4.7 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Inpatient Rehabilitation Facilities, 1997 Stroke


Number of MedPAR records sent by CMS : 1,460,199 Number of IRF records: 121,806 records from 1,143 IRFs
Numer of records sent by UDSMR : 294,907 records from 655 IRFs
Selected records : Stroke diagnosis admitted & discharged in 1997 FFS
Selected records : Stroke diagnosis admitted & discharged in 1997 Medicare FFS
Number of MedPAR records: 57,365 records from 1,121 IRFs
Number of UDSMR records : 51,619 records from 644 IRFs
Number of records linked: 32,219 records from 606 IRFs
Exclusion criteria applied
Number of linked records available for analysis: 26,076 records from 604 IRFs

MedPAR refers to Medicare Payment and Review Record, CMS, Centers for Medicare and Medicaid Services; UDSMR, Uniform Data System for Medical Rehabilitation; IRF, Inpatient Rehabilitation Facility; FFS, fee-for-service

Figure 4.8 Number of Records Received from CMS and UDSMR and Number of Records after Applying the Exclusion Criteria, Skilled Nursing Facilities, 1997 Stroke


Number of MedPAR records sent by CMS : 466,283 records from 15,778 SNFs
Numer of records sent by UDSMR : 58,519 records from 277 SNFs
Selected records : Stroke diagnosis admitted & discharged in 1997 FFS
Selected records : Stroke diagnosis admitted & discharged in 1997 Medicare FFS
Number of MedPAR records: 158,084 records from 14,856 SNFs
Number of UDSMR records : 4,620 records from 251SNFs
Number of records linked: 3,360 records from 225 SNFs
Exclusion criteria applied
Number of linked records available for analysis: 2,303 records from 208 SNFs

MedPAR refers to Medicare Payment and Review Record, CMS, Centers for Medicare and Medicaid Services; UDSMR, Uniform Data System for Medical Rehabilitation; SNF, Skilled Nursing Facility; FFS, fee-for-service

Table 4.70 Demographic and Hospitalization Characteristics of Patients with Stroke by Rehabilitation Setting, 1997 (n = 28,379)

Characteristic	Inpatient Rehabilitation Facility (n=26,076)	Skilled Nursing Facility (n=2,303)	P
Age (yr)			< .001
Mean (SD)	76.1 (8.5)	79.4 (8.3)	
Median	77	80	
25th and 75th percentiles	71 – 82	74 – 85	
Minimum and Maximum	23 — 104	29 — 101	
Sex (%)			< .001
Female	55.4	61.0	
Male	44.6	39.0	
Race (%)			< .001
White	83.5	89.7	
Non-white	16.5	10.3	
Dually eligible for Medicare and Medicaid (%)			< .001
Medicare and Medicaid	10.1	7.1	
Median household income based on ZIP code (1993 US Dollars)			< .001
Mean (SD)	32,374 (12,332)	37,036 (13,171)	
Median	29,889	34,257	
25th and 75th percentiles	24,175 – 38,182	27,553 – 43,447	
Minimum and maximum	5,000 – 123,335	8,787 – 132,593	
Marital status (%)			< .001
Not currently married	52.2	61.0	
Married	47.8	39.0	
Lived alone prior to stroke (%)			< .001
Lived alone	32.1	36.4	
Lived with others	67.9	63.6	
Pre-hospital living setting (%)			< .001
Home	97.8	95.5	
Board & care, transitional living	2.2	4.5	
Admit from (%)			< .001
Community-based setting	4.9	2.2	
Acute care unit	94.0	97.0	
Alternate level of care	1.1	0.8	
Time from stroke to rehabilitation admission (days)			< .001
Mean (SD)	8.7 (7.9)	10.9 (10.2)	
Median	6	7	
25th and 75th percentiles	4 – 10	4 – 13	
Minimum and maximum	0 — 60	0 — 60	
Length of rehabilitation stay (days)			< .001
Mean (SD)	20.0 (11.1)	24.7 (18.7)	
Median	18	20	
25th and 75th percentiles	12 – 26	12 – 30	
Minimum and maximum	4 — 103	4 — 133	

Table 4.70 (cont'd)

Characteristic	IRF (n=26,076)	SNF (n=2,303)	P
Time from onset to rehabilitation discharge (days)			< .001
Mean (SD)	28.7 (14.4)	35.7 (23.1)	
Median	26	29	
25th and 75th percentiles	18 – 36	20 – 44	
Minimum and maximum	4 — 137	5 — 172	
Discharge setting (%)			< .001
Community	78.1	69.5	
Non-community	21.9	30.5	
Stroke etiology (%)			.046
Ischemia	89.2	90.6	
Hemorrhage	10.8	9.4	
Comorbidities/complications (%)			.076
Tier 1 (most serious)	0.5	0.3	
Tier 2 (moderately serious)	2.0	1.3	
Tier 3 (least serious)	9.4	8.9	
None of listed comorbidities	88.1	89.4	
Case-Mix Group distribution (%)			< .001
101 to 103 mild disability	7.3	10.8	
104 to 105 mild to moderate disability	26.2	23.3	
106 to 107 moderate disability	21.3	17.0	
108 to 109 moderate severe disability	11.5	10.8	
110 to 114 severe disability	33.7	38.1	
Admission motor FIM rating			< .001
Mean (SD)	41.7 (14.5)	40.2 (16.6)	
Median	43	41	
25th and 75th percentiles	31 – 52	27 – 53	
Minimum and maximum	13 — 91	13 — 91	
Admission cognitive FIM rating			.512
Mean (SD)	22.6 (8.3)	22.5 (9.4)	
Median	23	24	
25th and 75th percentiles	17 – 29	15 – 31	
Minimum and maximum	5 — 35	5 — 35	
Discharge motor FIM rating			< .001
Mean (SD)	61.8 (18.0)	57.6 (21.3)	
Median	65	62	
25th and 75th percentiles	51 – 76	42 – 75	
Minimum and maximum	13 — 91	13 — 91	
Discharge cognitive FIM rating			.001
Mean (SD)	25.9 (7.6)	24.8 (8.8)	
Median	28	27	
25th and 75th percentiles	21 – 32	19 – 32	
Minimum and maximum	5 — 35	5 — 35	

P = probability; yr = years; SD = standard deviation; ZIP = Zone Improvement Plan; FIM = Functional Independence Measure; IRF = Inpatient Rehabilitation Facility; SNF = Skilled Nursing Facility.

Significance levels determined using Mann-Whitney *U* and Chi-square tests.

Patient Characteristics – 1997 Stroke Database (cont'd)

The case-mix distribution showed that IRFs admitted a lower percentage of patients in with mild disabilities (Case-Mix Groups 101 to 103) and severe disabilities (Case-Mix Groups 110 to 114), and a higher percentage of patients from the middle groups (Case-Mix Groups 104 to 109).

Motor FIM ratings on admission and discharge were higher for IRF patients. The median motor FIM rating for IRF patients was 43 and 41 for SNF patients; median discharge FIM ratings were 65 and 62, respectively. Cognitive FIM ratings were not significantly different between the 2 groups on admission (p = .512); cognitive ratings may have been higher for patients in IRFs at the time of discharge, but the difference was small (median was 28 for IRFs and 27 for SNFs).

Reliability of FIM Ratings – 1997 Stroke Database

Cronbach's alpha was used to assess the reliability of FIM ratings for IRF and SNF patient records. Results for the 1997 stroke database, presented in Table 4.71, show that reliability coefficients were all above .80 indicating good reliability.[109] As with the other databases analyzed, the values for the SNF records were slightly higher than coefficients for the IRF records.

Table 4.71 Cronbach's Alpha for FIM Data, Patients with Stroke, 1997 (n= 28,379)

Rating Scale	Inpatient Rehabilitation Facility (n = 26,076)		Skilled Nursing Facility (n = 2,303)	
	Cronbach's Alpha	95% CI	Cronbach's Alpha	95% CI
Admission motor FIM ratings (13 items)	.925	.924 to .927	.936	.932 to .940
Admission cognitive FIM ratings (5 items)	.928	.926 to .929	.951	.948 to .954
Discharge motor FIM ratings (13 items)	.963	.962 to .964	.967	.965 to .969
Discharge cognitive FIM ratings (5 items)	.935	.934 to .937	.955	.952 to .957

FIM refers to Functional Independence Measure; CI, confidence interval

Facility-Level Market Characteristics – 1997 Stroke Database

The 1997 stroke database included patient records from 604 IRFs and 208 SNFs. The characteristics of these facilities by rehabilitation setting are presented in Table 4.72.

Fewer than one-quarter of the IRFs were freestanding facilities, whereas almost 70 percent of SNFs were freestanding facilities. The most frequent geographic locations for IRFs were the East North Central region (24.5% of facilities), the South Atlantic region (16.6%), and the West South Central region (16.4%). The highest percentages of SNFs were located in the East North Central region (22.6%), the Middle Atlantic region (17.3%), and the South Atlantic region (15.9%).

Table 4.72 Characteristics of Facilities by Rehabilitation Setting, Patients with Stroke, 1997 (n = 812 facilities)

Characteristic	Inpatient Rehabilitation Facility (n=604)	Skilled Nursing Facility (n=208)	P
Type of facility (%)			< .001
Freestanding	22.0	68.8	
Distinct unit	78.0	31.2	
Rural status (%)			.490
Rural	9.3	7.7	
Geographic location* (%)			< .001
New England	3.5	12.1	
Middle Atlantic	11.3	17.3	
East North Central	24.5	22.6	
West North Central	7.9	7.2	
South Atlantic	16.6	15.9	
East South Central	4.3	0.5	
West South Central	16.4	5.8	
Mountain	5.1	6.7	
Pacific	10.4	12.0	
Volume: number of patients (all payers)			< .001
Mean (SD)	133.3 (89.9)	37.7 (30.0)	
Median	111	29	
25th and 75th percentiles	72.3 – 173	15 – 54	
Minimum and maximum	4 — 542	1 — 158	
Managed care penetration in county (%)			< .001
Mean (SD)	27.8 (17.2)	33.3 (15.7)	
Median	26.3	30.9	
25th and 75th percentiles	14.8 – 41.1	23.5 – 44.1	
Minimum and Maximum	0 — 80.0	0 — 74.5	
Patients in facility with managed care insurance (%)			.104
Mean (SD)	7.7 (10.1)	13.1 (18.9)	
Median	3.8	4.8	
25th and 75th percentiles	0.4 – 11.8	0 – 17.7	
Minimum and Maximum	0 — 86.0	0 — 93.0	
JCAHO accreditation (self-reported, %)			< .001
Yes	91.7	4.8	
No	8.3	95.2	
CARF accreditation (self-reported, %)			< .001
Yes	73.2	17.3	
No	26.8	82.7	
Number of operating beds			.059
Mean (SD)	33.5 (25.8)	28.5 (19.3)	
Median	25	24.5	
25th and 75th percentiles	16 – 40	16 – 34.75	
Minimum and Maximum	5 — 270	2 — 163	

Table 4.72 (cont'd)

Characteristic	IRF (n=604)	SNF (n=208)	P
Facility ownership			< .001
Government (Federal, state, county, local)	7.9	3.4	
Non-government, non-church-affiliated, not-for-profit	43.9	26.0	
Church-affiliated, non-government, not-for-profit	23.7	15.4	
Church-affiliated, for profit	0.8	1.0	
For profit, non-church-affiliated	16.2	50.0	
Other, unspecified	6.6	4.3	
Number of records in analysis			< .001
Mean (SD)	43.2 (38.2)	11.1 (11.4)	
Median	34	7	
25th and 75th percentiles	16 – 56	3 – 17	
Minimum and Maximum	1 — 238	1 — 78	

P refers to probability; SD, standard deviation; JCAHO, Joint Commission on Accreditation of Healthcare Organizations; CARF, Commission on Accreditation of Rehabilitation Facilities; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Significance levels determined using Mann-Whitney *U* (continuous variables) and Chi-square (categorical) tests.
* See Appendix A: Glossary of Terms for a list of the States included in each geographic region.

Facility Characteristics – 1997 Stroke Database (cont'd)

In 1997, IRFs in the study treated a median of 111 patients with stroke (all payers), while the SNFs treated a median of 29 patients with stroke per facility. Managed care penetration was slightly lower in the counties where IRFs were located, but the percents of patients with managed care in the IRFs and SNFs were not different.

The JCAHO accredited more than 90 percent of IRFs, and 4.8 percent of SNFs. More than 70 percent of IRFs and 17.3 percent of SNFs were accredited by CARF.

IRFs had a slightly higher number of operating beds in their facilities, with half of the IRFs reporting between 16 to 40 beds (25th to 75th percentile), and SNFs reporting 16 to 34.75 beds.

More than 67 percent of the IRFs were not-for-profit (including both non-church- and church-affiliated entities), whereas just over half (51.0%) of SNFs were for-profit entities (including both non-church- and church-affiliated entities).

The mean number of records per facility used in the 1997 stroke database was 34 for IRFs and 7 for SNFs.

Research Question 4: Did the Percentage of Patients with Stroke Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1997?

Preparing the Data for Logistic Regression Analyses

Logistic regression was used to test whether the percentages of patients with stroke discharged to the community were different for IRFs and SNFs. The 14 covariates were entered into the regression model prior to the rehabilitation setting variable to control for differences in patient and facility factors prior to testing the effect of the rehabilitation setting.

Prior to executing the regression analyses, the distribution of each continuous covariate was examined. If indicated, data were transformed based on the procedure (e.g., logarithm, square root) which best provided a normal distribution as evidenced by the lowest Kolmogorov-Smirnov statistic.

Correlations between each of the transformed covariates and the independent variable were reviewed to assess for the potential of multicollinearity. All correlations were weaker than 0.5. The strongest correlation was 0.482 between the transformed values of the admission motor FIM ratings and the admission cognitive FIM ratings.

The first series of regression models tested for effect-measure modification using cross-product terms. Statistically significant interactions were found between 1) admission motor FIM ratings and the rehabilitation setting ($p < .001$), and 2) age and rehabilitation setting ($p = .001$). The 3-way interaction of admission motor FIM ratings, age and the rehabilitation setting showed borderline significance with a p value of .050.

The cross-product term of living alone prior to stroke and rehabilitation setting was not significant ($p = .497$).

Based on the effect-measure modification results, the 1997 stroke database was stratified into 4 groups based on Case-Mix Group assignment and the median age of 77. The four groups were: 1) the records of patients with mild to moderate

disability (Case-Mix Groups 101 to 107) who were 77 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were 78 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 77 years of age or younger, 4) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 78 years of age or older.

Once data were stratified into the 4 groups, the distribution of each continuous covariate was examined, and data, if indicated, were transformed.

Pearson correlations between each of the transformed covariates and the independent variable were reviewed; all correlations were below the absolute value of 0.5. For each the 4 groups, the strongest correlation was detected between the variable of rehabilitation setting and the transformed values of volume of cases. Correlations were 0.394 for Group 1, 0.484 for Group 2, 0.427 for Group 3 and 0.436 for Group 4.

The Percent of Patients Discharged to the Community from Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The unadjusted (i.e., no adjustment for covariates) percents of patients with stroke discharged to the community for IRFs and SNFs were examined prior to running the regression analyses, and results are reported in Table 4.73.

The unadjusted percentages of patients discharged to community-based settings from IRFs and SNFs among patients who had mild to moderate disability and were younger than 78 years of age (Group 1) were not different (p = .102).

Among older patients with mild to moderate disability (Group 2), 5.1 percent more patients who received care in IRFs were discharged to the community (87.8% for IRFs and 82.7% of SNFs).

For patients with severe disabilities (Group 3 and Group 4), the percentage of patients discharged to the community was higher for IRFs by 15.4 and 3.9 percent for younger (Group 3) and older patients (Group 4), respectively.

Table 4.73 Unadjusted Percent of Patients with Stroke Discharged to Community-Based Settings by Rehabilitation Setting, 1997 (n = 28,379)

Group		Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	**Mild to moderate disability & age ≤ 77 years**	93.0% (n= 8,083)	91.0% (n = 469)	.102
2	**Mild to moderate disability & age ≥ 78 years**	87.8% (n = 6,221)	82.7% (n = 709)	< .001
3	**Severe disability & age ≤ 77 years**	69.4% (n = 6,186)	54.0% (n = 437)	< .001
4	**Severe disability & age ≥ 78 years**	55.1% (n = 5,586)	51.2% (n = 688)	.048

Significance levels determined using Chi-square test.

Logistic Regression Results for the 1997 Stroke Database

Results of the logistic regression analyses for the 4 case-mix/age groups are reported in tables 4.74, 4.75, 4.76 and 4.77. The 14 covariates were entered into the regression models prior to the rehabilitation setting variable. As with the other regression analyses, coefficients for covariates are reported in the tables, but are not discussed. Some data were transformed, and coefficients for some of these variables may be unstable.[112] Results for covariates using untransformed data are shown and discussed in Appendix F (Tables F.21 to F.24).

Among younger (age ≤ 77 years) patients with mild to moderate disability (Group 1; Table 4.74), no statistically significant effect was found (p = .317) between the 2 rehabilitation settings after controlling for covariates.

Patients with mild to moderate disability who were older than 77 years of age (Group 2; Table 4.75), and patients with severe disabilities who were younger than 78 years of age (Group 3; Table 4.76) the adjusted odds ratios were 1.52 (95% CI was 1.16 to 1.98; p = .002) and 1.41 (95% CI was 1.11 to 1.80; p = .005), respectively.

For patients with severe disabilities who were older than 77 years (Group 4; Table 4.77), no statistical significant difference was detected (p = .420) between the 2 types of rehabilitation settings, after adjusting for covariates.

Table 4.74 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger, 1997 (n = 8,552)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time (*logarithm base 10*)	-0.287	0.136	4.42	0.035	0.75	0.57	0.98
Admission motor FIM rating (*logarithm base 10*)	7.026	0.726	93.62	< .001	1125.3	271.12	4670.3
Admission cognitive FIM rating (*square*)	0.002	0.000	125.7	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	0.054	0.141	0.14	0.704	1.06	0.80	1.39
Tier 1 comorbidity (present =1)	3.496	3.589	0.95	0.330	32.98	0.03	37399
Tier 2 comorbidity (present =1)	-0.428	0.289	2.20	0.138	0.65	0.37	1.15
Tier 3 comorbidity (present =1)	-0.330	0.139	5.65	0.017	0.72	0.55	0.94
Age (*cube*)	0.000	0.000	6.38	0.012	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-0.777	0.091	72.70	< .001	0.46	0.38	0.55
Median household income (*logarithm base 10*)	-0.189	0.302	0.39	0.531	0.83	0.46	1.50
Sex (female =1)	-0.022	0.090	0.06	0.810	0.98	0.82	1.17
Race (white =1)	0.338	0.126	7.20	0.007	1.40	1.10	1.79
Volume of patients (*logarithm base 10*)	0.353	0.161	4.84	0.028	1.42	1.04	1.95
County managed care penetration (*no transformation*)	0.079	0.279	0.08	0.777	1.08	0.63	1.87
Rehabilitation setting (IRF=1, SNF=0)	0.196	0.196	1.00	0.317	1.22	0.83	1.79
Constant	-9.483	1.863	25.91	< .001	0.00	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.75 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 101 to 107 and 78 Years of Age or Older, 1997 (n = 6,930)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	0.091	0.114	0.63	0.427	1.10	0.88	1.37
Admission motor FIM rating (*logarithm base 10*)	7.597	0.664	130.92	< .001	1992.8	542.35	7322.4
Admission cognitive FIM rating (*square*)	0.002	0.000	161.12	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	-0.298	0.125	5.64	0.018	0.74	0.58	0.95
Tier 1 comorbidity (present =1)	0.380	0.760	0.25	0.618	1.46	0.33	6.48
Tier 2 comorbidity (present =1)	-0.393	0.327	1.45	0.229	0.67	0.36	1.28
Tier 3 comorbidity (present =1)	-0.373	0.142	6.86	0.009	0.69	0.52	0.91
Age (*logarithm base 10*)	-7.367	1.726	18.22	< .001	0.00	0.00	0.02
Pre-hospital living alone (alone =1)	-0.633	0.080	63.28	< .001	0.53	0.45	0.62
Median household income (*logarithm base 10*)	-1.124	0.268	17.54	< .001	0.32	0.19	0.55
Sex (female =1)	-0.220	0.084	6.86	0.009	0.80	0.68	0.95
Race (white =1)	0.438	0.153	8.14	0.004	1.55	1.15	2.09
Volume of patients (*logarithm base 10*)	0.149	0.141	1.11	0.291	1.16	0.88	1.53
County managed care penetration (*no transformation*)	0.573	0.246	5.42	0.020	1.77	1.09	2.87
Rehabilitation setting (IRF=1, SNF=0)	0.418	0.136	9.44	0.002	1.52	1.16	1.98
Constant	6.826	3.785	3.25	0.071	921.86	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.76 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 77 Years of Age or Younger, 1997 (n = 6,623)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time (*logarithm base 10*)	0.024	0.084	0.08	0.773	1.02	0.87	1.21
Admission motor FIM rating (*square*)	0.001	0.000	337.8	< .001	1.00	1.00	1.00
Admission cognitive FIM rating (*square*)	0.001	0.000	50.60	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	-0.102	0.081	1.56	0.212	0.90	0.77	1.06
Tier 1 comorbidity (present =1)	0.275	0.338	0.66	0.416	1.32	0.68	2.55
Tier 2 comorbidity (present =1)	0.014	0.167	0.01	0.933	1.01	0.73	1.41
Tier 3 comorbidity (present =1)	-0.141	0.086	2.68	0.101	0.87	0.73	1.03
Age (*cube*)	0.000	0.000	34.41	< .001	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-0.925	0.066	198.5	< .001	0.40	0.35	0.45
Median household income (*logarithm base 10*)	-0.469	0.194	5.84	0.016	0.63	0.43	0.92
Sex (female =1)	-0.064	0.059	1.21	0.272	0.94	0.84	1.05
Race (white =1)	0.432	0.076	32.63	< .001	1.54	1.33	1.79
Volume of patients (*logarithm base 10*)	0.146	0.106	1.89	0.169	1.16	0.94	1.43
County managed care penetration (*no transformation*)	-0.472	0.179	6.98	0.008	0.62	0.44	0.89
Rehabilitation setting (IRF=1, SNF=0)	0.344	0.124	7.73	0.005	1.41	1.11	1.80
Constant	1.951	0.900	4.70	0.030	7.04	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.77 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 78 Years of Age or Older, 1997 (n = 6,274)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	0.063	0.080	0.62	0.431	1.07	0.91	1.25
Admission motor FIM rating (*square*)	0.001	0.000	384.77	< .001	1.00	1.00	1.00
Admission cognitive FIM rating (*square*)	0.001	0.000	39.12	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	0.053	0.089	0.35	0.555	1.05	0.88	1.26
Tier 1 comorbidity (present =1)	-0.146	0.366	0.16	0.690	0.86	0.42	1.77
Tier 2 comorbidity (present =1)	0.002	0.184	0.00	0.990	1.00	0.70	1.44
Tier 3 comorbidity (present =1)	-0.094	0.094	0.99	0.319	0.91	0.76	1.10
Age (*logarithm base 10*)	-4.133	1.252	10.91	0.001	0.02	0.00	0.19
Pre-hospital living alone (alone =1)	-0.787	0.060	169.83	< .001	0.46	0.40	0.51
Median household income (*logarithm base 10*)	-0.868	0.189	21.12	< .001	0.42	0.29	0.61
Sex (female =1)	-0.023	0.059	0.16	0.692	0.98	0.87	1.10
Race (white =1)	0.654	0.089	54.58	< .001	1.92	1.62	2.29
Volume of patients (*square root*)	0.003	0.007	0.14	0.706	1.00	0.99	1.02
County managed care penetration (*no transformation*)	0.007	0.172	0.00	0.966	1.01	0.72	1.41
Rehabilitation setting (IRF=1, SNF=0)	-0.081	0.100	0.65	0.420	0.92	0.76	1.12
Constant	10.83	2.562	17.86	< .001	50454	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Transformations made to covariates are reported after the variable name in parentheses.

Post-Hoc Power Analyses for Logistic Regression Results – 1997 Stroke Database

As shown in Table 4.78, the estimated power for the logistic regression analyses with an alpha of 0.05 and an 5 percent difference in rates considered clinically important, was 99 percent for Group 1, 96 percent for Group 2, 55 percent for Group 3, and 70 percent for Group 4.

Although the estimated power for the third group was low, a statistically significant effect was detected. For the fourth group, statistical significance was 0.420; increasing the alpha to .10 increased the power of this analysis to 80 percent.

Table 4.78 Post-Hoc Power Estimates for Logistic Regression Analyses, 1997 Stroke Database (n = 28,379)

Group		IRF n	SNF n	Community Discharge – Percent		Alpha	Estimated Power
				low	high		
1	Mild to Moderate Disability & age ≤ 77 years	8,083	469	89	94	.05	.99
2	Mild to Moderate Disability & age ≥ 78 years	6,221	709	82	87	.05	.96
3	Severe Disability & age ≤ 77 years	6,186	437	58	63	.05	.55
						.10	.67
4	Severe Disability & age ≥ 78 years	5,586	688	50	55	.05	.70
						.10	.80

IRF refers to Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Assessment for Bias in Logistic Regression Results Due to Methodology – 1997 Stroke Database

As reported in the methods section, a median of 71.3 percent of IRF records and 81.7 percent of SNF records per facility were linked to create the 1997 stroke database. To determine whether the study methodology, including the procedures used to link the data, resulted in biased regression estimates, analyses of the UDSMR data for all Medicare fee-for-service patients with stroke were conducted. Results using the UDSMR data and results using the linked UDSMR/MedPAR data were compared to determine whether the linked data may have produced biased regression estimates.

The regression estimates, reported in Appendix G (Table G.7), were similar (i.e., within ± 15 %) for 2 of the 4 groups. For Group 1, the regression coefficient was 1.48 for the UDSMR data, and 1.22 for the linked MedPAR/UDSMR data. The odds ratio for the linked data was directed toward the null of 1.0. For Group 4, the estimates showed a switchover, however, neither estimate were statistically significant. The UDSMR estimate was 1.18, and the linked data had an estimate of .92.

This study included the records of patients who had typical stays. In the 1997 stroke database, 19.1 percent of IRF records and 31.5 percent of SNF records were excluded from analyses because they were considered "atypical" stays or

because FIM data were missing. To determine whether an alternative set of exclusion criteria would have led to different results, additional analyses of the UDSMR/MedPAR linked data were executed with 2 alternative exclusion criteria. Results of the study using the Original Study Exclusion Criteria (i.e., excluding “atypical” stays), and results using the 2 alternative exclusion criteria were compared.

The first set of alternative exclusion criteria, referred to as Exclusion Criteria A, was the same as the Original Study Exclusion Criteria, except that it included the records of patients who had program interruptions, patients who died and patients who were discharged to acute care hospitals. For the Exclusion Criteria A analyses, patients who died were considered to have had a non-community discharge.

The second set of alternative exclusion criteria, called Exclusion Criteria B, was the same as the Original Study Exclusion Criteria, with the additional exception of patients who were younger than 65. Individuals younger than 65 who were Medicare beneficiaries had a long-term disability or had renal failure.

Results of the logistic regression analyses using the Original Study Exclusion Criteria (reported in Tables 4.72, 4.73, 4.74 and 4.75) and results using Exclusion Criteria A and Exclusion Criteria B are reported in Appendix H (Table H.7).

The comparison of results using Exclusion Criteria A and results using the Original Study Exclusion Criteria showed that estimates were similar (i.e., within ±15%) for 3 of the 4 groups. For Group 2, the odds ratio for Exclusion Criteria A was 1.30, and the odds ratio for the Original Study Exclusion Criteria was 1.52. The Original Study Exclusion Criteria estimate was directed toward the null of 1.0.

The estimates for Exclusion Criteria B and the Original Study Exclusion Criteria were similar (i.e., within ±15%).

Summary of Logistic Regression Results – 1997 Stroke Database

The logistic regression analyses of the 1997 stroke database found that patients in Case-Mix Groups 101 to 107 who were older than 77, and patients in Case-Mix Groups 108 to 114 who were younger than 78 who were treated in IRFs were more likely to return to the community.

The percent of patients discharged to the community was not different for young patients in Case-Mix Groups 101 to 107 or older patients in Case-Mix Groups 108 to 114.

Research Question 5: Did the Functional Outcomes of Patients with Stroke Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1997?

Preparing Data for the Multiple Linear Regression Analyses

Multiple linear regression was used to test whether the discharge motor function status of patients with stroke was different if patients received treatment in an IRF or a SNF. As with all regression analyses used in this study, the 14 covariates were entered into the regression model prior to the rehabilitation setting variable to control for differences in patient sociodemographic, medical history and facility-level market factors.

The distribution of each continuous covariate was examined. If indicated, data were transformed. Correlations between each of the transformed covariates and the independent variable were reviewed to assess for the potential of multicollinearity. All correlations were weaker than 0.6.

Testing of this hypothesis began by using ANCOVA to assess for the presence of effect-measure modification. The analyses included calculating the Eta^2 to estimate the importance of the interactions. Statistically significant interactions were found between: 1) admission motor FIM ratings and the rehabilitation setting ($p < .001$; $\text{eta}^2 = <.001$), 2) age and rehabilitation setting ($p = .004$; $\text{eta}^2 =$

$<.001$), and 3) admission motor FIM ratings, age and the rehabilitation setting ($p < .001$; $eta^2 = .006$).

The interaction of living alone prior to condition onset and rehabilitation setting was not significant ($p = .268$).

Based on these interaction results, the 1997 stroke database was split into 4 groups based on Case-Mix Group assignment and the median age of 78 years for further analyses. The groups were: 1) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were 77 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were 78 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 77 years of age or younger, 4) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 78 years of age or older.

Once data were stratified into the 4 separate case-mix/age groups, the distribution of each continuous covariate was examined, and data were transformed, as indicated. Pearson correlations between each of the transformed covariates and the independent variable were weaker than 0.5.

Discharge Motor FIM Ratings of Patients Treated in Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The unadjusted discharge motor FIM ratings of IRF and SNF patients were compared for each case-mix/age group. These data, reported in Table 4.79, show that discharge motor FIM ratings were not different for patients in Group 1 and Group 2. Discharge FIM ratings were significantly different for patients with severe disabilities (Group 3 and Group 4). The mean IRF ratings were higher by 7.2 and 4.2 FIM units, respectively.

Table 4.79 Unadjusted Mean, Standard Deviation, and Median Motor FIM Ratings of Patients with Stroke by Group, 1997 (n = 28,379)

Group		Description	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	**Mild to moderate disability & 77 years of age or younger**	Number	8,083	469	.604
		Mean (SD)	73.5 (10.6)	73.1 (10.8)	
		Median	75	75	
2	**Mild to moderate disability & 78 years of age or older**	Number	6,221	709	.315
		Mean (SD)	71.6 (9.9)	71.5 (11.4)	
		Median	73	73	
3	**Severe disability & 77 years of age or younger**	Number	6,186	437	< .001
		Mean (SD)	50.4 (16.7)	43.2 (18.3)	
		Median	52	44	
4	**Severe disability & 78 years of age or older**	Number	5,586	688	< .001
		Mean (SD)	46.5 (16.6)	41.7 (18.7)	
		Median	48	41	

FIM refers to Functional Independence Measure; P, probability; SD, standard deviation
Significance levels determined using Mann-Whitney *U* procedure.

Multiple Linear Regression Results for the 1997 Stroke Database

Results of the multiple regression analyses for each of the four case-mix/age groups are reported in tables 4.80, 4.81, 4.82 and 4.83. As with the other regression analyses, coefficients for covariates are reported in these tables, but are not discussed since coefficients for some of these transformed variables may be unstable.[112] The results for covariates using untransformed data are reported and discussed in Appendix F (Tables F.29 to F.32).

For the patients with mild to moderate disability who were 77 years of age or younger (Group 1; Table 4.80) a statistically significant effect of 1.49 motor FIM units was found ($p <.001$; R^2 change = .001). Thus, after adjusting for covariates, patients with stroke discharged from IRFs achieved a higher discharge FIM rating of approximately 1.5 units.

For the patients with mild to moderate disability who were 78 years of age or older (Group 2; Table 4.81), an effect of 1.22 FIM units was found ($p = .001$; R^2 change = .001).

For the patients with severe disabilities (Group 3; Table 4.82 and Group 4; Table 4.83), statistically significant effects were also detected. For younger patients, a difference of 4.17 FIM units was found ($p <.001$; R^2 change = .003). For patients older than 77 years, the difference was 1.48 motor FIM units ($p = .008$; R^2 change = .001).

Table 4.80 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 years of Age or Younger, 1997 Stroke Database (n = 8,552)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	-60.37	3.56	--	-16.95	< .001	-67.36	-53.39
Onset time (*logarithm base 10*)	-1.54	0.27	-0.05	-5.64	< .001	-2.07	-1.00
Admission motor FIM rating (*logarithm base 10*)	75.20	1.30	0.52	57.96	< .001	72.65	77.74
Admission cognitive FIM rating (*square*)	0.00	0.00	0.16	18.17	< .001	0.00	0.01
Type of stroke (hemorrhage = 1)	1.17	0.29	0.04	3.99	< .001	0.59	1.74
Tier 1 comorbidity (present =1)	-0.21	1.35	0.00	-0.15	0.879	-2.86	2.45
Tier 2 comorbidity (present =1)	-1.78	0.70	-0.02	-2.56	0.010	-3.15	-0.42
Tier 3 comorbidity (present =1)	-1.27	0.30	-0.04	-4.22	< .001	-1.85	-0.68
Age (*cube*)	0.00	0.00	-0.02	-2.38	0.017	0.00	0.00
Pre-hospital living alone (alone =1)	1.40	0.20	0.06	7.08	< .001	1.01	1.78
Median household income (*logarithm base 10*)	0.49	0.61	0.01	0.81	0.419	-0.70	1.68
Sex (female = 1)	-0.32	0.18	-0.02	-1.80	0.072	-0.67	0.03
Race (white = 1)	-0.82	0.24	-0.03	-3.47	0.001	-1.28	-0.36
Volume of patients (*logarithm base 10*)	-0.33	0.33	-0.01	-1.00	0.319	-0.97	0.31
County managed care penetration (*no transformation*)	0.78	0.57	0.01	1.37	0.170	-0.33	1.89
Rehabilitation setting (IRF = 1, SNF = 0)	1.49	0.43	0.03	3.51	< .001	0.66	2.33

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.81 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older, 1997 Stroke Database (n = 6,930)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	7.59	9.97	--	0.76	0.446	-11.95	27.12
Onset time (*logarithm base 10*)	-0.70	0.29	-0.02	-2.40	0.016	-1.28	-0.13
Admission motor FIM rating (*logarithm base 10*)	79.70	1.52	0.51	52.39	< .001	76.72	82.68
Admission cognitive FIM rating (*square*)	0.01	0.00	0.20	20.12	< .001	0.01	0.01
Type of stroke (hemorrhage = 1)	-0.09	0.35	0.00	-0.27	0.787	-0.78	0.59
Tier 1 comorbidity (present =1)	0.14	1.75	0.00	0.08	0.937	-3.29	3.57
Tier 2 comorbidity (present =1)	-0.54	0.91	-0.01	-0.60	0.551	-2.32	1.24
Tier 3 comorbidity (present =1)	-0.83	0.39	-0.02	-2.12	0.034	-1.60	-0.06
Age (*logarithm base 10*)	-39.97	4.62	-0.08	-8.66	< .001	-49.02	-30.92
Pre-hospital living alone (alone =1)	1.54	0.21	0.08	7.50	< .001	1.14	1.94
Median household income (*logarithm base 10*)	0.07	0.67	0.00	0.10	0.919	-1.25	1.38
Sex (female = 1)	-0.55	0.21	-0.03	-2.67	0.008	-0.96	-0.15
Race (white = 1)	-1.45	0.34	-0.04	-4.27	< .001	-2.12	-0.79
Volume of patients (*logarithm base 10*)	-0.45	0.36	-0.01	-1.26	0.206	-1.16	0.25
County managed care penetration (*no transformation*)	0.37	0.62	0.01	0.60	0.548	-0.84	1.59
Rehabilitation setting (IRF = 1, SNF = 0)	1.22	0.37	0.04	3.27	0.001	0.49	1.96

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.82 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger, 1997 Stroke Database (n = 6,623)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	19.67	4.97	--	3.96	< .001	9.93	29.41
Onset time (*logarithm base 10*)	-0.93	0.47	-0.02	-1.98	0.048	-1.85	-0.01
Admission motor FIM rating (*square*)	0.02	0.00	0.57	54.76	< .001	0.02	0.02
Admission cognitive FIM rating (*square*)	0.01	0.00	0.12	11.64	< .001	0.01	0.01
Type of stroke (hemorrhage = 1)	3.57	0.47	0.07	7.65	< .001	2.65	4.48
Tier 1 comorbidity (present =1)	1.75	1.83	0.01	0.96	0.337	-1.83	5.33
Tier 2 comorbidity (present =1)	-2.22	0.95	-0.02	-2.35	0.019	-4.08	-0.37
Tier 3 comorbidity (present =1)	-1.42	0.49	-0.03	-2.93	0.003	-2.38	-0.47
Age (*cube*)	0.00	0.00	-0.05	-4.70	< .001	0.00	0.00
Pre-hospital living alone (alone =1)	0.98	0.38	0.02	2.58	0.010	0.24	1.72
Median household income (*logarithm base 10*)	2.39	1.07	0.02	2.23	0.026	0.29	4.49
Sex (female = 1)	-1.34	0.33	-0.04	-4.11	< .001	-1.98	-0.70
Race (white = 1)	-2.27	0.40	-0.06	-5.65	< .001	-3.06	-1.49
Volume of patients (*logarithm base 10*)	-0.40	0.59	-0.01	-0.67	0.500	-1.56	0.76
County managed care penetration (*no transformation*)	-0.43	0.99	0.00	-0.44	0.663	-2.38	1.52
Rehabilitation setting (IRF =1, SNF = 0)	4.17	0.72	0.06	5.78	< .001	2.75	5.58

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.83 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Moderate to Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older, 1997 Stroke Database (n = 6,274)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	103.76	14.45	--	7.18	< .001	75.43	132.09
Onset time (*logarithm base 10*)	-1.38	0.45	-0.03	-3.04	0.002	-2.27	-0.49
Admission motor FIM rating (*square*)	0.02	0.00	0.60	60.82	< .001	0.02	0.02
Admission cognitive FIM rating (*square*)	0.01	0.00	0.15	15.34	< .001	0.01	0.01
Type of stroke (hemorrhage = 1)	2.47	0.51	0.04	4.86	< .001	1.47	3.47
Tier 1 comorbidity (present =1)	0.54	2.05	0.00	0.27	0.791	-3.47	4.55
Tier 2 comorbidity (present =1)	0.59	1.05	0.01	0.56	0.573	-1.46	2.65
Tier 3 comorbidity (present =1)	-1.18	0.53	-0.02	-2.20	0.028	-2.22	-0.13
Age (*logarithm base 10*)	-48.98	7.08	-0.06	-6.92	< .001	-62.86	-35.11
Pre-hospital living alone (alone =1)	1.51	0.34	0.04	4.44	< .001	0.84	2.17
Median household income (*logarithm base 10*)	2.90	1.06	0.03	2.74	0.006	0.83	4.97
Sex (female = 1)	-1.53	0.33	-0.04	-4.62	< .001	-2.18	-0.88
Race (white = 1)	-0.54	0.48	-0.01	-1.13	0.259	-1.48	0.40
Volume of patients (*square root*)	0.04	0.04	0.01	0.98	0.328	-0.04	0.12
County managed care penetration (*no transformation*)	-0.85	0.97	-0.01	-0.88	0.380	-2.76	1.05
Rehabilitation setting (IRF = 1, SNF = 0)	1.48	0.56	0.03	2.63	0.008	0.38	2.59

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

As discussed previously, in this study, only differences of 2 FIM units or greater were considered clinically important. Thus, for the 1997 stroke database, the patients with severe disabilities who were younger than 78 were the only group who showed higher FIM ratings that were clinically important after participating in the IRF programs.

Multicollinearity was not a concern for any of the multiple regression models used; the highest variance inflation factor values within each model were 1.228 for the first group, 1.393 for the second group, 1.272 for the third group and 1.302 for the last group. These values are below the value of 4, which could indicate a potential problem.[113]

Histograms of the standardized regression residuals for each model showed residuals were generally normally distributed, addressing the regression assumption of normality.

Post-Hoc Power Analyses for Multiple Linear Regression Results – 1997 Stroke Database

As shown in Table 4.84, the post-hoc analyses estimated power of greater than 99 percent for all 4 groups.

Table 4.84 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1997 Stroke Database (n = 28,379)

Group		Number of Patient Records	Adjusted R^2	Effect Size: Incremental R^2 Increase	Alpha	Estimated Power
1	**Mild to Moderate Disability & age $\leq$ 77 years**	8,552	.342	.005	.05	.99
2	**Mild to Moderate Disability & age $\geq$ 78 years**	6,930	.372	.005	.05	.99
3	**Severe Disability & age $\leq$ 77 years**	6,623	.411	.005	.05	.99
4	**Severe Disability & age $\geq$ 78 years**	6,274	.480	.005	.05	.99

R^2 refers to multiple coefficient of determination

Assessment for Bias in Logistic Regression Results Due to Methodology – 1997 Stroke Database

As reported in the methods section, a median of 71.3 percent of IRF records per facility and 81.7 percent of SNF records per facility were linked to create the 1997 stroke database. To determine whether the study methodology, including the procedures used to link the data, resulted in biased regression estimates, analyses of all the UDSMR data for Medicare fee-for-service patients with stroke were conducted. Results using the UDSMR data and results using the linked UDSMR/MedPAR data were compared.

The regression estimates, reported in Appendix G (Table G.8), did not appear to show any obvious bias. The regression estimates for each of the 4 case-mix/age

groups were similar (i.e., within ± 15%) for the UDSMR data and the linked UDSMR/MedPAR data.

In the 1997 stroke database, 19.1 percent of IRF records and 31.5 percent of SNF records were excluded from analyses because they were “atypical” stays or because FIM data were missing. To determine whether an alternative set of exclusion criteria would have led to different results, additional analyses of the UDSMR/MedPAR linked data were executed with 2 alternative exclusion criteria. Results of the study using the Original Study Exclusion Criteria (i.e., excluding “atypical” stays), and results using the 2 alternative exclusion criteria were compared.

The first set of alternative exclusion criteria, referred to as Exclusion Criteria A, was the same as the Original Study Exclusion Criteria, with the exception that it included the records of patients who had program interruptions, patients who died and patients who were discharged to acute care hospitals. For the Exclusion Criteria A analysis, the discharge motor FIM ratings for patients who died were recoded to 13 (i.e., dependent in all motor activities).

The second set of alternative exclusion criteria, called Exclusion Criteria B, was the same as the study exclusion criteria, with the additional exclusion of patients who were younger than 65. Individuals younger than 65 who were Medicare beneficiaries had a long-term disability or had renal failure.

Results of the logistic regression analyses using the Original Study Exclusion Criteria (reported in Tables 4.80, 4.81, 4.82 and 4.83) and results using Exclusion Criteria A and Exclusion Criteria B are reported in Appendix H (Table H.8).

A comparison of the results using Exclusion Criteria A and results using the Original Study Exclusion Criteria showed that the regression coefficients were similar (i.e., within ± 0.75 FIM units). The regression coefficients were also similar when Exclusion Criteria B and the Study Exclusion Criteria were applied.

Summary of Multiple Linear Regression Results – 1997 Stroke Database

The multiple linear regression analyses of the 1997 stroke database found that patients with severe disabilities who were younger than 78 and who were treated in IRFs had higher FIM ratings that were clinically important, when compared to patients treated in SNFs. For the other 3 groups, statistically significant differences were found, but the coefficients showed a small effect, which may not be clinically important.

Research Question 6: Did Medicare Payments for Patients with Stroke Treated in IRFs Differ from Medicare Payments for Patients Treated in SNF-Based Rehabilitation Care across all Case-Mix Groups in 1997?

Payments to Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) – 1997 Stroke Database

As shown in Table 4.85, in the 1997 stroke database, the median Medicare Part A payment per patient was $12,350 for IRFs and $6,057 (both in 1997 U.S. Dollars) for SNF-based rehabilitation programs.

When payment amounts were standardized to reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education, the difference remained significant. The median payment per patient to IRFs was $12,665, and $5,944 to SNFs, a difference of $6,721; the median IRF payment was more than double the SNF payment.

The median of payment per patient received by facilities from Medicare Part A, other primary payers and patients was $12,553 for IRF patients, and $6,400 for SNF patients.

Approximately 82.4 percent of IRF patients and 52.4 percent of SNF patients had no liabilities.

Table 4.85 Medicare Part A Payment Data for Fee-for-Service Patients with Stroke by Rehabilitation Setting, 1997 (n = 28,379)

Type of Payment	Inpatient Rehabilitation Facility (n=26,076)	Skilled Nursing Facility (n=2,303)	P
Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
Mean (SD)	14,108 (8,830)	7,753 (6,478)	
Median	12,350	6,057	
25th and 75th percentiles	7,820 – 18,312	3,720 – 9,916	
Minimum and maximum	0 — 97,134	0 — 104,168	
Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
Mean (SD)	14,480 (8,982)	7,661 (6,430)	
Median	12,665	5,944	
25th and 75th percentiles	8,003 - 18,953	3,678 – 9,698	
Minimum and maximum	0 — 92,153	0 — 95,676	
Payments to facility* (1997 U.S. Dollars)			< .001
Mean (SD)	14,397 (8,976)	8,703 (7,828)	
Median	12,553	6,400	
25th and 75th percentiles	8,050 – 18,525	3,801 – 11,156	
Minimum and Maximum	0 — 112,714	0 — 109,963	
Patient liability (1997 U.S. Dollars)			< .001
Patients with liability (%)	82.4	52.4	
Mean (SD)	198 (747)	885 (1,596)	
Median	0	0	
25th and 75th percentiles	0 – 0	0 – 1,140	
Minimum and maximum	0 — 19,380	0 — 7,609	

SD refers to standard deviation.
Significance levels determined using Mann-Whitney *U* procedure.
Patient liability includes co-insurance and deductibles. Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education.
* Payments from Medicare Part A, other primary payers and patients; does not include payments from Medicare Part B.

Medicare Payments and Length of Stay by Case-Mix Group Assignment – 1997 Stroke Database

When payment data were analyzed separately for 5 groups based on the Case-Mix Group classification system, the unadjusted and standardized Medicare Part

A payments remained statistically significantly different across all 5 groups, with IRF payments always higher (Table 4.86).

For Case-Mix Groups 101 to 103, the difference between the median IRF standardized payment and the median SNF standardized payment was $2,379; the median IRF payment was 62.9% higher than median SNF payment. For Case-Mix Groups 104 and 105, the difference increased to $4,370 (87.1% higher than SNF payment). For Case-Mix Groups 106 and 107, 108 and 109, and 110 to 114 had differences of $7,088 (120.2% higher than SNF payment), $8,669 (130.8% higher than SNF payment), and $9,539 (121.5% higher than SNF payment), respectively.

The rehabilitation stays of IRF patients tended to be shorter than the stays of patients in SNFs. For patients in Case-Mix Groups 101 to 103, the median LOS was 9 days for IRFs and 11 days for SNFs, a difference of 2 days. The median stays for IRFs and SNFs were 14 and 16 days for patients in Case-Mix Groups 104 and 105, 18 and 20 days for patients in Case-Mix Groups 106 and 107, and 21 and 21.5 days for patients in Case-Mix Groups 108 and 109. For patients in Case-Mix Groups 110 to 114, the median stay for both IRF and SNF patients was 24 days; however, the 25th and 75th percentiles were 17 to 32 for IRFs and 16 to 39 for SNFs.

Table 4.86 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Stroke by Case-Mix Group and by Rehabilitation Setting, 1997 (n = 28,379)

Case-Mix Group	Variable	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
101 to 103	**Number of patient records**	**1,901**	**249**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	6,981 (4,363)	4,585 (3,346)	
	Median	6,012	3,792	
	25th and 75th percentiles	4,200 – 8,638	2,284 – 6,013	
	Minimum and maximum	0 — 48,966	0 — 19,474	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	7,167 (4,490)	4,572 (3,397)	
	Median	6,163	3,784	
	25th and 75th percentiles	4,287 – 8,934	2,236 – 5,839	
	Minimum and maximum	0 — 54,400	0 — 20,038	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	10.3 (5.5)	15.0 (12.7)	
	Median	9	11	
	25th and 75th percentiles	7 – 13	7 – 18	
	Minimum and maximum	4 — 59	4 — 91	
104 and 105	**Number of patient records**	**6,843**	**537**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	10,106 (5,567)	5,585 (3,482)	
	Median	9,082	5,028	
	25th and 75th percentiles	6,230 – 12,850	3,056 - 7,608	
	Minimum and maximum	0 — 56,191	0 — 18,813	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	10,408 (5,828)	5,520 (3,401)	
	Median	9,388	5,018	
	25th and 75th percentiles	6,399 – 13,137	3,044 – 7,455	
	Minimum and maximum	0 — 79,038	0 — 18,875	
	Rehabilitation length of stay , days			< .001
	Mean (SD)	14.5 (7.0)	18.6 (11.8)	
	Median	14	16	
	25th and 75th percentiles	9 – 18	11 – 23	
	Minimum and maximum	4 — 77	4 — 100	

Table 4.86 (cont'd)

Case-Mix Group	Variable	IRF	SNF	P
106 and 107	**Number of patient records**	**5,560**	**392**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	13,673 (7,176)	7,252 (4,909)	
	Median	12,600	6,075	
	25th and 75th percentiles	8,769 – 17,298	4,024 – 9,154	
	Minimum and maximum	0 — 73,132	0 — 35,655	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	14,027 (7,342)	7,127 (4,890)	
	Median	12,986	5,898	
	25th and 75th percentiles	8,856 – 17,808	3,931 – 8,937	
	Minimum and maximum	0 — 67,748	0 — 36,545	
	Rehabilitation length of stay (days)			.001
	Mean (SD)	19.4 (8.9)	23.4 (15.5)	
	Median	18	20	
	25th and 75th percentiles	13 – 24	13 – 29	
	Minimum and maximum	4 — 91	4 — 100	
108 and 109	**Number of patient records**	**2,990**	**248**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	15,931 (8,216)	8,390 (5,776)	
	Median	14,766	6,611	
	25th and 75th percentiles	10,345 – 20,462	4,225 – 11,226	
	Minimum and maximum	0 — 85,773	0 — 33,965	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	16,319 (8,339)	8,262 (5,737)	
	Median	15,298	6,629	
	25th and 75th percentiles	10,658 – 20,927	4,095 – 11,055	
	Minimum and maximum	0 — 64,014	0 — 37,496	
	Rehabilitation length of stay (days)			.120
	Mean (SD)	22.6 (10.1)	26.4 (17.6)	
	Median	21	21.5	
	25th and 75th percentiles	15 – 28	14 – 33.75	
	Minimum and maximum	4 — 76	5 — 124	

Table 4.86 (cont'd)

Case-Mix Group	Variable	IRF	SNF	P
110 to 114	**Number of patient records**	**8,782**	**877**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	18,425 (10,216)	10,024 (8,270)	
	Median	16,800	7,750	
	25th and 75th percentiles	11,390 – 23,595	4,844 – 12,989	
	Minimum and maximum	0 — 97,134	0 — 104,168	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	18,896 (10,279)	9,916 (8,217)	
	Median	17,392	7,853	
	25th and 75th percentiles	11,717 – 24,293	4,768 – 12,860	
	Minimum and maximum	0 — 92,153	0 — 95,676	
	Rehabilitation length of stay (days)			.003
	Mean (SD)	25.8 (12.6)	31.4 (22.7)	
	Median	24	24	
	25th and 75th percentiles	17 – 32	16 – 39.5	
	Minimum and maximum	4 — 103	4 — 145	

SD refers to standard deviation
Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education.
Significance levels determined using Mann-Whitney *U* procedure.

Summary of Medicare Payment Analyses – 1997 Stroke Database

Medicare Part A payments to IRFs were significantly higher than payments made to SNFs for patients with stroke in 1997. The difference between the median payment remained when data were stratified into the 5 groups based on the Case-Mix Group classification system, ranging from $2,379 for Case-Mix Groups 101 to 103 to $9,539 for Case-Mix Groups 110 to 114.

Although payments to IRFs were higher, the LOS for patients in IRFs tended to be shorter than the stays of patients in SNFs when stratified by Case-Mix Group.

Results from the Combined 1996 and 1997 Stroke Databases

The 1996 stroke database and the 1997 stroke database were combined, and the outcomes and payment analyses were conducted on the combined databases.

Research Question 4: Did the Percentage of Patients with Stroke Discharged to the Community Differ for IRFs Versus SNF-Based Rehabilitation Programs in 1996 and 1997?

Preparing the Data for Logistic Regression Analyses

Logistic regression was used to test whether the percentages of patients with stroke discharged to the community were different for IRFs and SNFs in the combined 1996 and 1997 data. The 14 covariates were entered into the regression model prior to the rehabilitation setting variable to control for differences in patient and facility factors prior to testing the effect of the rehabilitation setting.

Based on the separate analyses of the 1996 and 1997 data, the combined 1996 and 1997 data were stratified into 4 groups based on Case-Mix Group assignment and the median age of 77. The four groups were: 1) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were

77 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were 78 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 77 years of age or younger, 4) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 78 years of age or older.

Once data were stratified into the 4 groups, the distribution of each continuous covariate was examined, and data, if indicated, were transformed.

Pearson correlations between each of the transformed covariates and the independent variable were reviewed; all correlations were below the absolute value of 0.5. For each the 4 groups, the strongest correlation was detected between the variable of rehabilitation setting and the transformed values of volume of cases. Correlations were 0.307 for Group 1, 0.468 for Group 2, 0.399 for Group 3 and 0.425 for Group 4.

The Percent of Patients Discharged to the Community from Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The unadjusted (i.e., no adjustment for covariates) percents of patients with stroke discharged to the community for IRFs and SNFs were examined prior to running the regression analyses, and results are reported in Table 4.87.

For each of the 4 groups, the percentage of patients discharged to the community was higher for IRFs than for SNFs. The differences in the percentages were 2.4 for Group 1, 5.1 for Group 2, 15.4 for Group 3 and 7.1 for Group 4.

Table 4.87 Unadjusted Percent of Patients with Stroke Discharged to Community-Based Settings by Rehabilitation Setting, 1996 and 1997 (n = 58,724)

Group		Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	**Mild to moderate disability & age ≤ 77 years**	93.3% (n= 17,091)	90.9% (n = 807)	< .001
2	**Mild to moderate disability & age ≥ 78 years**	87.4% (n = 13,002)	82.3% (n = 1,103)	< .001
3	**Severe disability & age ≤ 77 years**	69.2% (n = 13,317)	53.8% (n = 772)	< .001
4	**Severe disability & age ≥ 78 years**	56.1% (n = 11,504)	49.0% (n = 1,128)	< .001

Significance levels determined using Chi-square test.

Logistic Regression Results for the Combined 1996 and 1997 Stroke Databases

Results of the logistic regression analyses for the 4 case-mix/age groups are reported in tables 4.88, 4.89, 4.90 and 4.91. The 14 covariates were entered into the logistic regression models prior to the rehabilitation setting variable.

As with the other regression analyses, coefficients for covariates are reported in these tables, but are not discussed. Some data were transformed, and coefficients for some of these variables may be unstable.[112]

Table 4.88 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger, 1996 and 1997 (n = 17,898)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	0.031	0.096	0.10	0.748	1.03	0.85	1.24
Admission motor FIM rating (*logarithm base 10*)	7.892	0.518	231.91	< .001	2675.9	969.07	7389.2
Admission cognitive FIM rating (*square*)	0.002	0.000	297.56	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	-0.105	0.097	1.19	0.275	0.90	0.74	1.09
Tier 1 comorbidity (present =1)	1.434	1.008	2.02	0.155	4.20	0.58	30.26
Tier 2 comorbidity (present =1)	-0.393	0.215	3.35	0.067	0.68	0.44	1.03
Tier 3 comorbidity (present =1)	-0.326	0.099	10.85	0.001	0.72	0.59	0.88
Age (*cube*)	0.000	0.000	25.84	< .001	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-1.055	0.064	272.51	< .001	0.35	0.31	0.39
Median household income (*logarithm base 10*)	-0.170	0.212	0.64	0.424	0.84	0.56	1.28
Sex (female =1)	-0.010	0.064	0.03	0.869	0.99	0.87	1.12
Race (white =1)	0.312	0.090	12.06	0.001	1.37	1.15	1.63
Volume of patients (*logarithm base 10*)	0.017	0.008	4.16	0.041	1.02	1.00	1.03
County managed care penetration (*no transformation*)	-0.175	0.195	0.81	0.367	0.84	0.57	1.23
Rehabilitation setting (IRF=1, SNF=0)	0.473	0.139	11.56	0.001	1.61	1.22	2.11
Constant	-10.60	1.306	65.86	< .001	0.00	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.89 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 101 to 107 and 78 Years of Age or Older, 1996 and 1997 (n = 14,105)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time (*logarithm base 10*)	0.070	0.081	0.75	0.387	1.07	0.92	1.26
Admission motor FIM rating (*logarithm base 10*)	8.138	0.463	309.60	< .001	3421.8	1382.2	8471.1
Admission cognitive FIM rating (*square*)	0.001	0.000	311.29	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	-0.274	0.087	10.00	0.002	0.76	0.64	0.90
Tier 1 comorbidity (present =1)	-0.149	0.503	0.09	0.767	0.86	0.32	2.31
Tier 2 comorbidity (present =1)	-0.109	0.240	0.21	0.650	0.90	0.56	1.44
Tier 3 comorbidity (present =1)	-0.119	0.106	1.26	0.262	0.89	0.72	1.09
Age (*logarithm base 10*)	-8.512	1.197	50.59	< .001	0.00	0.00	0.00
Pre-hospital living alone (alone =1)	-0.742	0.055	180.29	< .001	0.48	0.43	0.53
Median household income (*logarithm base 10*)	-0.646	0.186	12.03	0.001	0.52	0.36	0.76
Sex (female =1)	-0.163	0.058	7.91	0.005	0.85	0.76	0.95
Race (white =1)	0.459	0.108	18.14	< .001	1.58	1.28	1.96
Volume of patients (*logarithm base 10*)	0.138	0.098	1.99	0.158	1.15	0.95	1.39
County managed care penetration (*no transformation*)	0.473	0.169	7.81	0.005	1.61	1.15	2.24
Rehabilitation setting (IRF=1, SNF=0)	0.348	0.105	10.97	0.001	1.42	1.15	1.74
Constant	6.065	2.599	5.44	0.020	430.35	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.90 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 77 Years of Age or Younger, 1996 and 1997 (n = 14,089)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	-0.041	0.058	0.49	0.484	0.96	0.86	1.08
Admission motor FIM rating (*square*)	0.001	0.000	734.90	< .001	1.00	1.00	1.00
Admission cognitive FIM rating *(square)*	0.001	0.000	104.05	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	-0.002	0.057	0.00	0.977	1.00	0.89	1.12
Tier 1 comorbidity (present =1)	0.036	0.209	0.03	0.864	1.04	0.69	1.56
Tier 2 comorbidity (present =1)	-0.114	0.117	0.95	0.330	0.89	0.71	1.12
Tier 3 comorbidity (present =1)	-0.181	0.059	9.29	0.002	0.83	0.74	0.94
Age (*cube*)	0.000	0.000	51.89	< .001	1.00	1.00	1.00
Pre-hospital living alone (alone =1)	-0.939	0.045	431.13	< .001	0.39	0.36	0.43
Median household income (*logarithm base 10*)	-0.494	0.132	14.02	< .001	0.61	0.47	0.79
Sex (female =1)	-0.032	0.040	0.64	0.423	0.97	0.90	1.05
Race (white =1)	0.352	0.052	46.72	< .001	1.42	1.29	1.57
Volume of patients (*logarithm base 10*)	0.002	0.005	0.15	0.703	1.00	0.99	1.01
County managed care penetration (*no transformation*)	-0.365	0.123	8.88	0.003	0.69	0.55	0.88
Rehabilitation setting (IRF=1, SNF=0)	0.414	0.089	21.87	< .001	1.51	1.27	1.80
Constant	2.157	0.602	12.82	< .001	8.64	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility
Transformations made to covariates are reported after the variable name in parentheses.

Table 4.91 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Stroke in Case-Mix Groups 108 to 114 and 78 Years of Age or Older, 1996 and 1997 (n = 12,632)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time (*logarithm base 10*)	0.044	0.057	0.60	0.437	1.04	0.94	1.17
Admission motor FIM rating (*square*)	0.001	0.000	685.64	< .001	1.00	1.00	1.00
Admission cognitive FIM rating (*square*)	0.001	0.000	79.12	< .001	1.00	1.00	1.00
Type of stroke (hemorrhage = 1)	-0.056	0.064	0.77	0.381	0.95	0.83	1.07
Tier 1 comorbidity (present =1)	-0.099	0.260	0.14	0.703	0.91	0.54	1.51
Tier 2 comorbidity (present =1)	-0.157	0.134	1.36	0.243	0.86	0.66	1.11
Tier 3 comorbidity (present =1)	-0.150	0.067	4.95	0.026	0.86	0.75	0.98
Age (*logarithm base 10*)	-3.870	0.884	19.15	< .001	0.02	0.00	0.12
Pre-hospital living alone (alone =1)	-0.784	0.042	343.80	< .001	0.46	0.42	0.50
Median household income (*logarithm base 10*)	-0.719	0.132	29.71	< .001	0.49	0.38	0.63
Sex (female =1)	-0.010	0.041	0.06	0.800	0.99	0.91	1.07
Race (white =1)	0.744	0.063	140.12	< .001	2.10	1.86	2.38
Volume of patients (*square root*)	0.002	0.005	0.16	0.692	1.00	0.99	1.01
County managed care penetration (*no transformation*)	0.096	0.121	0.63	0.426	1.10	0.87	1.40
Rehabilitation setting (IRF=1, SNF=0)	0.023	0.076	0.09	0.760	1.02	0.88	1.19
Constant	9.661	1.808	28.56	< .001	15694	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility

Transformations made to covariates are reported after the variable name in parentheses.

Patients with mild to moderate disability (Group 1 and Group 2; Table 4.88 and Table 4.89), and patients with severe disabilities who were younger than 78 years of age (Group 3; Table 4.90) who were treated in IRFs were more likely to return to the community when compared to patients treated in SNF-based programs, after adjusting for covariates. Patients treated in IRFs were approximately 61 percent (95% CI was 1.22 to 2.11; p = .001), 42 percent (95% CI was 1.15 to 1.74; p = .001), and 51 percent (95% CI was 1.27 to 1.80; p < .001) more likely to return to the community, respectively.

For patients with severe disabilities who were older than 77 years (Group 4; Table 4.91), no statistical significant difference was detected (p = .760) between the 2 types of rehabilitation settings, after adjusting for covariates.

Post-Hoc Power Analyses for Logistic Regression Results – 1996 and 1997 Stroke Databases

As shown in Table 4.92, the estimated power for the logistic regression analyses with an alpha of 0.05 and an 5 percent difference in rates considered clinically important, was 99 percent for Group 1 and Group 2, 74 percent for Group 3, and 89 percent for Group 4.

Although the estimated power for the third group was below 80 percent, a statistically significant effect was detected in the regression analysis.

Table 4.92 Post-Hoc Power Estimates for Logistic Regression Analyses, 1996 and 1997 Stroke Databases (n = 58,724)

Group		IRF n	SNF n	Community Discharge – Percent		Alpha	Estimated power
				low	high		
1	**Mild to Moderate Disability & age ≤ 77 years**	17,091	807	89	94	.05	.99
2	**Mild to Moderate Disability & age ≥ 78 years**	13,002	1,103	82	87	.05	.99
3	**Severe Disability & age ≤ 77 years**	13,317	772	58	63	.05	.74
4	**Severe Disability & age ≥ 78 years**	11,504	1,128	50	55	.05	.89

IRF refers to Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Summary of Logistic Regression Results – 1996 and 1997 Stroke Databases

The logistic regression analyses of the combined 1996 and 1997 stroke databases found that patients in all Case-Mix Groups who were younger than 78, and older patients in Case-Mix Groups 101 to 107 who were treated in IRFs were more likely to return to the community.

The percent of patients discharged to the community was not different for older patients in Case-Mix Groups 108 to 114.

Research Question 5: Did the Functional Outcomes of Patients with Stroke Treated in IRFs Differ from those Achieved by Patients Treated in SNF-Based Rehabilitation Programs in 1996 and 1997?

Preparing Data for the Multiple Linear Regression Analyses

Multiple linear regression was used to test whether the discharge motor function status of patients with stroke was different if patients received treatment in an IRF or a SNF.

The combined 1996 and 1997 stroke databases were split into 4 groups based on Case-Mix Group assignment and the age of 77 years for further analyses. The groups were: 1) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were 77 years of age or younger, 2) the records of patients with mild to moderate disability (Case-Mix Groups 101 to 107) who were 78 years of age or older, 3) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 77 years of age or younger, 4) the records of patients with severe disability (Case-Mix Groups 108 to 114) who were 78 years of age or older.

Once data were stratified into the 4 separate case-mix/age groups, the distribution of each continuous covariate was examined, and data were

transformed, as indicated. Pearson correlations between each of the transformed covariates and the independent variable were weaker than 0.5.

Discharge Motor FIM Ratings of Patients Treated in Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) Prior to Adjusting for Covariates

The unadjusted discharge motor FIM ratings of IRF and SNF patients were compared for each group. These data, reported in Table 4.93, show that motor FIM ratings were not different for patients in Group 1 and Group 2. Discharge motor FIM ratings were significantly different for patients with severe disabilities (Group 3 and Group 4). The mean IRF ratings were higher by 8.3 and 6.4 FIM units, respectively.

Table 4.93 Unadjusted Mean, Standard Deviation, and Median Discharge Motor FIM Ratings of Patients with Stroke by Group, 1996 and 1997 (n = 58,724)

Group		Description	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
1	Mild to moderate disability & 77 years of age or younger	Number	17,091	807	.269
		Mean (SD)	73.6 (9.8)	73.7 (10.6)	
		Median	75	76	
2	Mild to moderate disability & 78 years of age or older	Number	13,002	1,103	.367
		Mean (SD)	71.6 (10.0)	71.0 (11.2)	
		Median	72	72	
3	Severe disability & 77 years of age or younger	Number	13,317	772	< .001
		Mean (SD)	50.6 (16.6)	42.3 (18.0)	
		Median	52	42	
4	Severe disability & 78 years of age or older	Number	11,504	1,128	< .001
		Mean (SD)	46.6 (16.6)	40.2 (18.5)	
		Median	48	39	

FIM refers to Functional Independence Measure; P, probability; SD, standard deviation
Significance levels determined using Mann-Whitney *U* procedure.

Multiple Linear Regression Results for the 1996 and 1997 Stroke Databases

Results of the multiple regression analyses for each of the four case-mix/age groups are reported in tables 4.94, 4.95, 4.96 and 4.97. As with the other regression analyses, coefficients for covariates are reported in these tables, but are not discussed since coefficients for some of these transformed variables may be unstable.[112]

For the patients with mild to moderate disability who were 77 years of age or younger (Group 1; Table 4.94) a statistically significant effect of 1.50 motor FIM units was found (95% CI: 0.89 to 2.10; $p < .001$; R^2 change = .001). For the patients with mild to moderate disability who were 78 years of age or older (Group 2; Table 4.95), an effect of 1.23 FIM units was found (95% CI: 0.65 to 1.80; $p < .001$; R^2 change = .001).

For the patients in the third group and fourth groups, who had severe disabilities (Tables 4.96 and 4.97), statistically significant effects were also detected. For younger patients, a mean difference of 4.87 FIM units was found (95% CI: 3.86 to 5.88; $p <.001$; R^2 change = .004). For patients older than 77 years, the mean difference was 2.27 motor FIM units (95% CI: 1.43 to 3.10; $p < .001$; R^2 change = .001).

Table 4.94 **Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 years of Age or Younger, 1996 and 1997 Stroke Databases (n = 17,898)**

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	-58.15	2.40	--	-24.22	< .001	-62.86	-53.45
Onset time (*logarithm base 10*)	-1.55	0.19	-0.05	-8.28	< .001	-1.92	-1.18
Admission motor FIM rating (*logarithm base 10*)	74.54	0.88	0.52	84.89	< .001	72.82	76.26
Admission cognitive FIM rating (*square*)	0.00	0.00	0.15	24.50	< .001	0.00	0.00
Type of stroke (hemorrhage = 1)	0.95	0.20	0.03	4.76	< .001	0.56	1.34
Tier 1 comorbidity (present =1)	-0.20	0.93	0.00	-0.22	0.828	-2.03	1.62
Tier 2 comorbidity (present =1)	-1.35	0.48	-0.02	-2.79	0.005	-2.30	-0.40
Tier 3 comorbidity (present =1)	-1.26	0.21	-0.04	-6.04	< .001	-1.66	-0.85
Age (*cube*)	0.00	0.00	-0.03	-4.33	< .001	0.00	0.00
Pre-hospital living alone (alone =1)	1.27	0.13	0.06	9.39	< .001	1.00	1.53
Median household income (*logarithm base 10*)	0.31	0.41	0.00	0.76	0.448	-0.49	1.11
Sex (female = 1)	-0.29	0.12	-0.01	-2.42	0.016	-0.53	-0.06
Race (white = 1)	-0.89	0.16	-0.04	-5.46	< .001	-1.20	-0.57
Volume of patients (*logarithm base 10*)	-0.03	0.02	-0.01	-1.74	0.082	-0.06	0.00
County managed care penetration (*no transformation*)	0.83	0.38	0.01	2.18	0.029	0.08	1.58
Rehabilitation setting (IRF = 1, SNF = 0)	1.50	0.31	0.03	4.87	< .001	0.89	2.10

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.95 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older, 1996 and 1997 Stroke Databases (n = 14,105)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	1.00	6.97	--	0.14	0.886	-12.66	14.67
Onset time (*logarithm base 10*)	-1.34	0.21	-0.04	-6.39	< .001	-1.76	-0.93
Admission motor FIM rating (*logarithm base 10*)	79.41	1.06	0.51	75.03	< .001	77.33	81.48
Admission cognitive FIM rating (*square*)	0.01	0.00	0.19	27.97	< .001	0.01	0.01
Type of stroke (hemorrhage = 1)	-0.25	0.24	-0.01	-1.01	0.314	-0.72	0.23
Tier 1 comorbidity (present =1)	0.06	1.38	0.00	0.04	0.967	-2.65	2.76
Tier 2 comorbidity (present =1)	-0.65	0.63	-0.01	-1.03	0.302	-1.89	0.59
Tier 3 comorbidity (present =1)	-0.94	0.28	-0.02	-3.31	0.001	-1.49	-0.38
Age (*logarithm base 10*)	-37.79	3.25	-0.08	-11.63	< .001	-44.16	-31.42
Pre-hospital living alone (alone =1)	1.49	0.14	0.07	10.31	< .001	1.20	1.77
Median household income (*logarithm base 10*)	0.82	0.47	0.01	1.75	0.081	-0.10	1.75
Sex (female = 1)	-0.56	0.14	-0.03	-3.83	< .001	-0.84	-0.27
Race (white = 1)	-1.00	0.24	-0.03	-4.11	< .001	-1.47	-0.52
Volume of patients (*logarithm base 10*)	-0.44	0.25	-0.01	-1.74	0.081	-0.94	0.05
County managed care penetration (*no transformation*)	0.25	0.43	0.00	0.58	0.562	-0.60	1.10
Rehabilitation setting (IRF = 1, SNF = 0)	1.23	0.29	0.03	4.20	< .001	0.65	1.80

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.96 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger, 1996 and 1997 Stroke Databases (n = 14,089)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	20.54	3.32	--	6.18	< .001	14.02	27.05
Onset time (*logarithm base 10*)	-1.43	0.32	-0.03	-4.45	< .001	-2.06	-0.80
Admission motor FIM rating (*square*)	0.02	0.00	0.57	79.99	< .001	0.02	0.02
Admission cognitive FIM rating (*square*)	0.01	0.00	0.12	16.91	< .001	0.01	0.01
Type of stroke (hemorrhage = 1)	3.62	0.32	0.07	11.16	< .001	2.98	4.25
Tier 1 comorbidity (present =1)	2.12	1.20	0.01	1.77	0.076	-0.23	4.47
Tier 2 comorbidity (present =1)	-2.47	0.67	-0.02	-3.70	< .001	-3.77	-1.16
Tier 3 comorbidity (present =1)	-1.56	0.33	-0.03	-4.65	< .001	-2.21	-0.90
Age (*cube*)	0.00	0.00	-0.05	-7.04	< .001	0.00	0.00
Pre-hospital living alone (alone =1)	0.67	0.26	0.02	2.56	0.010	0.16	1.18
Median household income (*logarithm base 10*)	2.17	0.73	0.02	2.99	0.003	0.75	3.60
Sex (female = 1)	-1.24	0.22	-0.04	-5.60	< .001	-1.67	-0.80
Race (white = 1)	-1.88	0.27	-0.05	-6.82	< .001	-2.41	-1.34
Volume of patients (*logarithm base 10*)	-0.05	0.03	-0.01	-1.84	0.066	-0.11	0.00
County managed care penetration (*no transformation*)	-0.75	0.68	-0.01	-1.10	0.272	-2.08	0.59
Rehabilitation setting (IRF =1, SNF = 0)	4.87	0.52	0.07	9.44	< .001	3.86	5.88

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

Table 4.97 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Moderate to Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older, 1996 and 1997 Stroke Databases (n = 12,632)

Variable	Unstandardized Coefficients		Beta	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	113.9	10.11	--	11.27	< .001	94.09	133.72
Onset time (*logarithm base 10*)	-1.53	0.32	-0.03	-4.84	< .001	-2.15	-0.91
Admission motor FIM rating (*square*)	0.02	0.00	0.61	87.03	< .001	0.02	0.02
Admission cognitive FIM rating (*square*)	0.01	0.00	0.15	21.88	< .001	0.01	0.01
Type of stroke (hemorrhage = 1)	2.06	0.36	0.04	5.71	< .001	1.35	2.76
Tier 1 comorbidity (present =1)	0.31	1.46	0.00	0.21	0.831	-2.55	3.17
Tier 2 comorbidity (present =1)	-0.02	0.75	0.00	-0.03	0.976	-1.50	1.45
Tier 3 comorbidity (present =1)	-1.13	0.38	-0.02	-2.98	0.003	-1.87	-0.39
Age (*logarithm base 10*)	-51.38	4.95	-0.07	-10.38	< .001	-61.09	-41.68
Pre-hospital living alone (alone =1)	1.29	0.24	0.04	5.46	< .001	0.83	1.75
Median household income (*logarithm base 10*)	1.64	0.73	0.02	2.24	0.025	0.20	3.08
Sex (female = 1)	-1.54	0.23	-0.04	-6.69	< .001	-1.99	-1.09
Race (white = 1)	-0.87	0.33	-0.02	-2.61	0.009	-1.52	-0.22
Volume of patients (*square root*)	0.01	0.03	0.00	0.43	0.664	-0.04	0.07
County managed care penetration (*no transformation*)	-0.49	0.68	0.00	-0.73	0.465	-1.82	0.83
Rehabilitation setting (IRF = 1, SNF = 0)	2.27	0.43	0.04	5.32	< .001	1.43	3.10

t refers to t value; P, probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Transformations made to covariates are reported after the variable name in parentheses.

As discussed previously, in this study, only differences of 2 FIM units or greater were considered clinically important. Thus, for the combined 1996 and 1997 stroke databases, the patients with severe disabilities were the only group who showed higher discharge FIM ratings that were clinically important after participating in the IRF programs.

Multicollinearity was not a concern for any of the multiple regression models used; the highest variance inflation factor values within each model were 1.175 for the first group, 1.346 for the second group, 1.218 for the third group and 1.277 for the last group. These values are below the value of 4, which could indicate a potential problem.[113]

Histograms of the standardized regression residuals for each model showed residuals were generally normally distributed, addressing the regression assumption of normality.

Post-Hoc Power Analyses for Multiple Linear Regression Results – 1996 and 1997 Stroke Databases

As shown in Table 4.98, the post-hoc analysis estimated power of greater than 99 percent for all 4 groups.

Table 4.98 Post-Hoc Power Estimates for Multiple Linear Regression Analyses, 1996 and 1997 Stroke Databases (n = 58,724)

Group		Number of Patient Records	Adjusted R^2	Effect Size: Incremental R^2 Increase	Alpha	Estimated Power
1	Mild to Moderate Disability & age $\leq$ 77 years	17,898	.343	.005	.05	.99
2	Mild to Moderate Disability & age $\geq$ 78 years	14,105	.369	.005	.05	.99
3	Severe Disability & age $\leq$ 77 years	14,089	.413	.005	.05	.99
4	Severe Disability & age $\geq$ 78 years	12,632	.487	.005	.05	.99

R^2 refers to multiple coefficient of determination

Research Question 6: Did Medicare Payments for Patients with Stroke Treated in IRFs Differ from Medicare Payments for Patients Treated in SNF-Based Rehabilitation Care across all Case-Mix Groups in 1996 and 1997?

Payments to Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs) – 1996 and 1997 Stroke Databases

A reported in Table 4.99, in the combined 1996 and 1997 stroke databases, the median Medicare Part A payment per patient was $12,377 for IRFs and $6,237 (both in 1997 U.S. Dollars) for SNF-based rehabilitation programs.

When payment amounts were standardized to reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education, the difference remained statistically significant. The

median payment per patient to IRFs was $12,719, and the median payment per patient to SNF-based rehabilitation programs was $6,140, a difference of $6,579; the median IRF payment was more than double the median SNF payment.

Table 4.99 Medicare Part A Payment Data for Fee-for-Service Patients with Stroke by Rehabilitation Setting, Combined 1996 and 1997 Databases (n = 58,724)

Type of Payment	Inpatient Rehabilitation Facility (n=54,914)	Skilled Nursing Facility (n=3,810)	P
Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
Mean (SD)	14,123 (8,836)	7,954 (6,493)	
Median	12,377	6,237	
25th and 75th percentiles	7,819 – 18,434	3,794 – 10,134	
Minimum and maximum	0 — 97,134	0 — 104,168	
Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
Mean (SD)	14,457 (9,004)	7,884 (6,540)	
Median	12,719	6,140	
25th and 75th percentiles	7,986 - 18,959	3,745 – 9,973	
Minimum and maximum	0 – 92,153	0 — 95,676	
Payments to facility* (1997 U.S. Dollars)			< .001
Mean (SD)	14,425 (9,009)	8,918 (7,744)	
Median	12,592	6,603	
25th and 75th percentiles	8,053 – 18,664	3,920 – 11,490	
Minimum and Maximum	0 — 112,714	0 – 109,963	
Patient liability (1997 U.S. Dollars)			< .001
Patients with liability (%)	82.5	50.4	
Mean (SD)	204 (772)	902 (1,552)	
Median	0	0	
25th and 75th percentiles	0 – 0	0 – 1,208	
Minimum and maximum	0 — 26,389	0 — 7,609	

SD refers to standard deviation.

Significance levels determined using Mann-Whitney *U* procedure.

Patient liability includes co-insurance and deductibles. Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education.

* Payments from Medicare Part A, other primary payers and patients; does not include payments from Medicare Part B.

The median of payment received by facilities from Medicare Part A, other primary payers and patients was $12,592 for each patient discharged from an IRF, and $6,603 for each patient discharged from a SNF-based rehabilitation program.

For some stays, patients were responsible for paying (either out-of-pocket or through a Medigap provider) a deductible, co-insurance or a blood deductible. Approximately 82.5 percent of IRF patients had no liabilities. For SNF patients, 50.4 percent had no liabilities.

Medicare Payments and Length of Stay by Case-Mix Group Assignment – 1996 and 1997 Stroke Databases

When payment data were analyzed separately for 5 groups based on the Case-Mix Group classification system, the unadjusted and standardized Medicare Part A payments remained statistically significantly different across all 5 groups, with IRF payments always higher (Table 4.100).

For Case-Mix Groups 101 to 103, the difference between the median IRF standardized payment and the median SNF standardized payment was $2,736; the median IRF payment was 78.5 percent higher than median SNF payment. For Case-Mix Groups 104 and 105, the difference increased to $4,443 (90.7% higher than SNF payment). For Case-Mix Groups 106 and 107, 108 and 109, and 110 to 114 had differences of $6,978 (116.8% higher than SNF payment),

$8,462 (114.6% higher than SNF payment), and $9,335 (115.8% higher than SNF payment), respectively.

The rehabilitation stays of IRF patients tended to be shorter than the stays of patients in SNFs. For patients in Case-Mix Groups 101 to 103, the median LOS was 9 days for IRFs and 11 days for SNFs, a difference of 2 days. The median stays for IRFs and SNFs were 14 and 16 days for patients in Case-Mix Groups 104 and 105, 18 and 20 days for patients in Case-Mix Groups 106 and 107. For patients in Case-Mix Groups 108 and 109, the median LOS was 22 in both IRFs and SNFs; however, the 25th and 75th percentiles were 16 to 28 for IRFs and 15 to 33 for SNFs. The median stays for patients in Case-Mix Groups 110 to 114 were 24 for IRFs and 25 for SNFs.

Summary of Medicare Payment Analyses – 1996 and 1997 Stroke Databases

Medicare Part A payments to IRFs were significantly higher than payments made to SNFs for patients with stroke in 1996 and 1997. The difference between the median payment remained when data were stratified into the 5 Case-Mix Groups, ranging from $2,736 for Case-Mix Groups 101 to 103 to $9,335 for Case-Mix Groups 110 to 114.

Although payments to IRFs were higher, the LOS for patients in IRFs tended to be shorter than the stays of patients in SNFs when stratified by Case-Mix Group.

Table 4.100 Medicare Part A Payment and Length of Stay Data for Fee-for-Service Patients with Stroke by Case-Mix Group and by Rehabilitation Setting, Combined 1996 and 1997 Databases (n = 58,724)

Case-Mix Group	Variable	Inpatient Rehabilitation Facility	Skilled Nursing Facility	P
101 to 103	**Number of patient records**	**4,093**	**382**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	7,108 (4,488)	4,446 (3,298)	
	Median	6,060	3,600	
	25th and 75th percentiles	4,237 – 8,855	2,231 – 5,890	
	Minimum and maximum	0 — 48,966	0 — 22,711	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	7,268 (4,602)	4,407 (3,276)	
	Median	6,220	3,484	
	25th and 75th percentiles	4,306 – 9,053	2,224 – 5,616	
	Minimum and maximum	0 — 54,400	0 — 20,340	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	10.7 (6.0)	14.4 (12.3)	
	Median	9	11	
	25th and 75th percentiles	7 – 13	7 – 17	
	Minimum and maximum	4 — 63	4 — 99	
104 and 105	**Number of patient records**	**14,183**	**901**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	10,128 (5,641)	5,656 (3,618)	
	Median	9,086	4,971	
	25th and 75th percentiles	6,230 – 12,896	3,084 - 7,569	
	Minimum and maximum	0 — 56,191	0 — 24,855	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	10,396 (5,844)	5,612 (3,607)	
	Median	9,344	4,901	
	25th and 75th percentiles	6,382 – 13,211	3,044 - 7,454	
	Minimum and maximum	0 — 79,038	0 — 25,138	
	Rehabilitation length of stay, days			< .001
	Mean (SD)	14.9 (7.3)	18.9 (12.2)	
	Median	14	16	
	25th and 75th percentiles	9 – 19	11 – 23	
	Minimum and maximum	4 — 77	4 — 105	

Table 4.100 (cont'd)

Case-Mix Group	Variable	IRF	SNF	P
106 and 107	**Number of patient records**	**11,817**	**627**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	13,640 (7,150)	7,243 (4,612)	
	Median	12,612	6,256	
	25th and 75th percentiles	8,759 – 17,315	4,128 – 9,229	
	Minimum and maximum	0 — 73,132	0 — 35,655	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	13,947 (7,315)	7,148 (4,647)	
	Median	12,952	5,974	
	25th and 75th percentiles	8,902 – 17,757	4,019 – 9,165	
	Minimum and maximum	0 — 67,748	0 — 36,545	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	19.7 (9.1)	23.7 (15.6)	
	Median	18	20	
	25th and 75th percentiles	14 – 24	14 – 29	
	Minimum and maximum	4 — 99	4 — 100	
108 and 109	**Number of patient records**	**6,414**	**374**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	15,896 (8,179)	8,520 (5,998)	
	Median	14,821	6,723	
	25th and 75th percentiles	10,261 – 20,324	4,377 – 11,153	
	Minimum and maximum	0 — 85,773	0 — 45,309	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	16,245 (8,330)	8,363 (6,018)	
	Median	15,255	6,793	
	25th and 75th percentiles	10,542 – 20,798	4,226 – 10,981	
	Minimum and maximum	0 — 67,163	0 — 48,629	
	Rehabilitation length of stay (days)			.086
	Mean (SD)	23.1 (10.3)	26.7 (17.6)	
	Median	22	22	
	25th and 75th percentiles	16 – 28	15 – 33	
	Minimum and maximum	4 — 88	4 — 124	

Table 4.100 (cont'd).

Case-Mix Group	Variable	IRF	SNF	P
110 to 114	**Number of patient records**	**18,407**	**1,526**	
	Medicare Part A payment, unadjusted (1997 U.S. Dollars)			< .001
	Mean (SD)	18,455 (10,225)	10,342 (8,071)	
	Median	16,890	8,100	
	25th and 75th percentiles	11,353 – 23,771	5,058 – 13,571	
	Minimum and maximum	0 — 97,134	0 — 104,168	
	Medicare Part A payment, standardized (1997 U.S. Dollars)			< .001
	Mean (SD)	18,889 (10,355)	10,281 (8,163)	
	Median	17,399	8,064	
	25th and 75th percentiles	11,669 – 24,331	4,971 – 13,288	
	Minimum and maximum	0 — 92,153	0 — 95,676	
	Rehabilitation length of stay (days)			< .001
	Mean (SD)	26.5 (13.0)	31.5 (21.6)	
	Median	24	25	
	25th and 75th percentiles	17 – 33	16 – 41	
	Minimum and maximum	4 — 109	4 — 145	

SD refers to standard deviation

Standardized payment data reflect a wage index of 1.000, and no adjustments for rural location, disproportionate low-income patients, or indirect medical education.

Significance levels determined using Mann-Whitney *U* procedure.

CHAPTER 5: DISCUSSION

This chapter includes an overview of significant findings, consideration of study findings given existing research, a review of the study's strengths and limitations, suggestions for further research, and finally a discussion of the implications for practice.

Overview of Significant Findings

This retrospective cohort study examined the outcomes and costs of rehabilitation care in IRFs and SNFs for patients with hip fracture and patients with stroke in 1996 and 1997. IRFs provide intensive rehabilitation services to patients over a short course, whereas the SNF-based programs provide varying levels of rehabilitation treatments typically over a longer period of time.

Patients with Hip Fracture

A summary of the study results for patients with hip fracture (combined 1996 and 1997 databases) is presented in Table 5.1. The first column shows that among patients with hip fracture who had mild to moderate disabilities and were younger than 83 (Group 1), the percentage of patients discharged to the community was not different for IRFs and SNFs.

Among patients older than 82 years with mild to moderate disabilities (Group 2) and all patients with severe disabilities (Group 3 and Group 4), those treated in IRFs were less likely to be discharged to the community than patients treated in SNFs.

The discharge motor functional status of patients with hip fracture treated in IRFs and SNF-based rehabilitation programs may not have been clinically different for the years 1996 and 1997. Motor FIM ratings for SNF patients were statistically significantly higher (i.e., indicating more independence) among patients with mild to moderate disabilities who were older than 82 years (Group 2), but the difference were small (i.e., less than 2 FIM units), and may not have been clinically important. For all other groups, FIM ratings were not different for IRF and SNF patients, after adjusting for covariates.

Medicare Part A payments to IRFs were significantly higher than payments to SNFs for patients with hip fracture in 1996 and 1997. This difference remained when patient records were analyzed separately by Case-Mix Group and payment data were standardized; median IRF payments were higher by 53.5 percent (Case-Mix Group 701) to 73.4 percent (Case-Mix Group 705).

Table 5.1 Summary of Regression Estimates of Effect of Rehabilitation Setting, Patients with Hip Fracture, Combined 1996 and 1997 Databases

Group	Type of Analysis	Logistic Regression: Odds Ratio	Multiple Linear Regression: Unstandardized β
	Independent Variable	IRF =1 and SNF = 0	IRF =1 and SNF = 0
	Dependent Variable	Discharge to Community	Discharge Motor FIM Ratings
Group 1: Mild/Moderate Disability & ≤ 82 Years of Age	Number of IRF records	9,132	9,132
	Number of SNF records	1,480	1,480
	Regression Coefficient (95% CI)	0.94 (0.74 to 1.18)	-0.27 (-0.66 to 0.11)
	P	.583	.165
Group 2: Mild/Moderate Disability & ≥ 83 Years of Age	Number of IRF records	5,513	5,513
	Number of SNF records	1,226	1,226
	Regression Coefficient (95% CI)	0.78 (0.64 to 0.95)	-0.65 (-1.13 to –0.18)
	P	.012	.007
Group 3: Severe Disability & ≤ 82 Years of Age	Number of IRF records	4,926	4,926
	Number of SNF records	955	955
	Regression Coefficient (95% CI)	0.82 (0.68 to 0.98)	0.56 (-0.26 to 1.39)
	P	.028	.182
Group 4: Severe Disability & ≥ 83 Years of Age	Number of IRF records	5,143	5,143
	Number of SNF records	1,418	1,418
	Regression Coefficient (95% CI)	0.73 (0.63 to 0.84)	-0.54 (-1.24 to 0.16)
	P	< .001	.132

IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Patients with Stroke

Results from analyses of records of patients with stroke (combined 1996 and 1997 databases) are summarized in Table 5.2. Patients with mild to moderate disabilities (Group 1 and Group 2) and younger patients with severe disabilities (Group 3) who received treatment in IRFs were more likely to be discharged to the community than patients treated in SNFs, after adjusting for covariates. The percent of patients discharged to the community from IRFs and SNFs was not different for patients with severe disabilities who were older than 77 years of age (Group 4).

Younger patients (Group 1 and Group 3) who were treated in IRFs were approximately 51 to 61 percent more likely to return to the community in 1996 and 1997, and older patients with mild to moderate disabilities were approximately 42 percent more likely to return to the community.

With regard to discharge functional status, patients with stroke who were treated in IRFs had statistically significantly higher FIM ratings (i.e., greater independence) than patients treated in SNFs across all 4 case-mix/age groups in 1996 and 1997. Among patients with mild to moderate disability (Group 1 and Group 2), differences were less than 2 FIM units, and may not have been clinically important.

Table 5.2 Summary of Regression Estimates of Effect of Rehabilitation Setting, Patients with Stroke, Combined 1996 and 1997 Databases

Group	Type of Analysis	Logistic Regression: Odds Ratio	Multiple Linear Regression: Unstandardized β
	Independent Variable	IRF =1 and SNF = 0	IRF =1 and SNF = 0
	Dependent Variable	Discharge to Community	Discharge Motor FIM Ratings
Group 1: Mild/Moderate Disability & ≤ 77 Years of Age	Number of IRF records	17,091	17,091
	Number of SNF records	807	807
	Regression Coefficient (95% CI)	1.61 (1.22 to 2.11)	1.50 (0.89 to 1.65)
	P	.001	< .001
Group 2: Mild/Moderate Disability & ≥ 78 Years of Age	Number of IRF records	13,002	13,002
	Number of SNF records	1,103	1,103
	Regression Coefficient (95% CI)	1.42 (1.15 to 1.74)	1.23 (0.65 to 1.80)
	P	.001	< .001
Group 3: Severe Disability & ≤ 77 Years of Age	Number of IRF records	13,317	12,120
	Number of SNF records	772	673
	Regression Coefficient (95% CI)	1.51 (1.27 to 1.80)	4.87 (3.86 to 5.88)
	P	< .001	< .001
Group 4: Severe Disability & ≥ 78 Years of Age	Number of IRF records	11,504	11,504
	Number of SNF records	1,128	1,128
	Regression Coefficient (95% CI)	1.02 (0.88 to 1.19)	2.27 (1.43 to 3.10)
	P	.760	< .001

IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

For patients with severe disabilities, both younger (Group 3) and older (Group 4) patients treated in IRFs achieved greater independence than patients treated in SNFs. For younger patients with severe disabilities (Group 3), IRF patients achieved ratings that were higher by approximately 4.9 FIM units, and for older patients with severe disabilities, IRF patients achieved ratings that were approximately 2.3 FIM units higher.

Medicare Part A payments to IRFs were significantly higher than payments to SNFs for patients with stroke in 1996 and 1997. This difference remained when patient records were analyzed separately by Case-Mix Group and payment data were standardized; IRF payments were higher by 78.5 percent (Case-Mix Groups 101 to 103) to 116.8 percent (Case-Mix Groups 110 to 114).

Characteristics of Patients Treated in Inpatient Rehabilitation Facilities (IRFs) and Skilled Nursing Facilities (SNFs)

Descriptive analyses in this study found that patients admitted to IRFs, when compared to patients admitted to SNF-based rehabilitation programs, were younger, slightly more likely to be male, more likely to be non-white, more likely to be on Medicaid, and more likely to be currently married. These findings were consistent for patients with hip fracture and patients with stroke for both years.

The distribution of patients by Case-Mix Group was different for IRFs and SNFs. Among patients with hip fracture, IRFs had a higher percent of patients in Case-Mix Groups 701 (mild disability), 702 (mild to moderate disability), 703 (moderate disability) and 704 (moderate to severe disability) than SNFs, and a lower percentage of patients with severe disabilities (Case-Mix Group 705). Among patients with stroke, IRFs had a higher percent of patients in the middle groups (Case-Mix Groups 104 to 109) than SNFs, and a lower percentage of patients with mild disabilities (Case-Mix Groups 101 to 103) and severe disabilities (Case-Mix Groups 110 to 114).

Consideration of Findings Given Existing Research – Hip Fracture

As reported in the review of the literature, Kramer et al.[18] compared the outcomes of patients with hip fracture treated in IRFs and SNF-based rehabilitation programs, and found that the percent of patients living in the community at 6 months was not different for the 2 settings. Since Kramer et al. reported data at 6 months, and did not stratify patients into subgroups, results are not directly comparable to results of the current study.

With regard to recovery of function, at 6 months, Kramer et al. did not find differences between patients treated in IRFs and patients treated in SNF-based rehabilitation programs. Analyses of subgroups of patients were conducted for functional status data; however, these analyses compared the functional status

of patients in IRFs with data from patients in all SNFs, both “subacute” programs and traditional SNFs, and thus analyses are not comparable to the current study.

Kane et al.[7] did study subgroups of patients, and reported that patients with hip fracture who were healthy and treated in an IRF had more functional improvement at 6 weeks, 6 months and 12 months than patients treated in SNFs. Among patients with hip fracture who were sick, functional improvement was not different for IRFs and SNFs. Patients in Kane’s study were considered healthy versus sick based on the patient’s functional status and cognitive status prior to the hip fracture, but the mean activity of daily living skill deficiency scores indicate pre-fracture function was associated with function at the time of acute care discharge.

Kane’s findings are different than the results in the current study, which found that the functional status of patients with hip fracture treated in IRFs and SNFs was probably not clinically different. The results were found for patients with mild to moderate disability as well as for patients with severe disability.

There are a number of important differences between Kane’s study and the current study that may explain why results for the patients who were healthier (Kane’s study)/mild to moderately disabled (current study) may have been different. First, Kane’s study compared the functional status of patients at 6 weeks, 6 months and 12 months, whereas the current study reported the

discharge destination of patients from the rehabilitation program, because follow-up data were not available. Second, Kane's study included data that were collected in 1988 and 1989 from facilities in 3 cities. In contrast, the current study included facilities from across the U.S., for the years 1996 and 1997, when SNF-based rehabilitation programs were more established. Another important difference between these studies is how the SNF-based rehabilitation programs were identified. Kane distinguished rehabilitation nursing homes from traditional nursing homes based on staffing and patient characteristics. In the current study, the SNFs that were included in the study voluntarily decided to collect rehabilitation data to monitor the outcomes of their programs.

Consideration of Findings Given Existing Research – Stroke

Kramer's study found that patients with stroke who were treated in IRFs had more recovery of their activities of daily living skills than patients treated in subacute rehabilitation programs, but the percentage of patients discharged to the community was not significantly different. Since Kramer et al. did not compare outcomes of IRFs and SNF-based rehabilitation programs for subgroups of patients, it is difficult to compare the results of their study with those of the current study.

Kane's study reported that both healthier and sicker patients achieved more functional improvement when treated in IRFs compared to patients treated in

SNF-based rehabilitation programs. The current study did find that motor FIM ratings for patients treated in IRFs were higher than the ratings for patients treated in SNFs, but the differences were small for patients with mild to moderate disabilities.

Strengths and Limitations

When interpreting the results of this study, it is important to consider both its limitations and its strengths.

The current study has several important limitations that would restrict the generalizability of its findings. First, the facilities included in this study were not randomly selected. The facilities in the study voluntarily submitted their data to a national rehabilitation database (i.e., UDSMR) in order to receive national benchmark data. The UDSMR database included approximately 60 percent of the IRFs in the U.S., but only 11 to 25 percent of SNFs that provided subacute rehabilitation services. Carter[103] reported that the characteristics of the Medicare fee-for-service patients in the UDSMR data are representative of Medicare patients. However, the SNFs included in this study were very likely different from the SNF-based rehabilitation programs that did not submit data to UDSMR. It should also be noted that CMS does not distinguish SNFs that specialize in providing rehabilitation services from traditional SNFs. The results of this study cannot be generalized to all SNFs or to all SNF-based rehabilitation programs.

A second reason that the study results may not reflect national experiences of all Medicare beneficiaries is that this study included only Medicare fee-for-service patients because the MedPAR files include only data from Medicare fee-for-service patients.[24] The experiences of Medicare beneficiaries in the Medicare+Choice program may be different from those of patients included in this study.

Third, the study data described the experiences of patients in 1996 and 1997, prior to the implementation of the SNF PPS in 1998 and the IRF PPS in 2002. Clinical practices in IRFs and SNFs have probably changed with new Medicare PPS-related incentives.[28] It is not known whether these changes have affected patient outcomes or Medicare payments.

Finally, in considering the generalizability of study findings, it is also important to recognize that this was an observational study, and patients were not randomly assigned to the rehabilitation settings. A variety of factors play a role in determining the type of rehabilitation care provided to patients, such as the severity of the patient's impairment, the availability of IRFs and SNF-based rehabilitation care in a geographic region, physician or patient preference, and managed care status. Although 14 patient- and facility-level covariates were considered in this study, many other factors, such as social support, nutritional status, and unrecorded comorbidities, were not available, and thus not included in analyses.

Several issues are important to consider regarding the accuracy and completeness of the data included in the study. First, the financial data in the MedPAR records tend to be very accurate because they are the actual amounts billed and reimbursed,[24] and this is a study strength.

Second, the linking of data from two sources meant that critical data, such as patient age, medical condition, admission date, and discharge date, were available for a very high percentage of the records. If data were not available in the data file from one source, it was often available in the file from the other source. In addition, comparisons of the records from the two sources showed that much of the demographic and hospitalization data were very accurate.

With regard to the quality of the functional assessment data, UDSMR has a number of procedures in place that promote accurate FIM data collection. In addition to offering education and data interpretation services, UDSMR requires that all data collectors take and pass a test to demonstrate their knowledge of the FIM instrument scoring rules. Nevertheless, FIM data are collected by many different clinicians, with varying FIM training experiences, and varying amounts of experience with FIM ratings, and whose primary focus was the treatment of patients.

The coding of diagnoses (i.e., ICD-9-CM codes) in the MedPAR files[24] and the UDSMR files may be incomplete, inaccurate or biased. Patients with similar presentations may have different diagnostic data reported (i.e., late effects of

stroke versus hemiplegia). In addition, the diagnostic data are reported without an indication of whether the diagnosis occurred prior to or after the admission; thus, it is not possible to distinguish comorbidities from complications.

Another strength of this study was the large sample size. The large number of patient records available permitted data to be stratified into age and Case-Mix Groups for further analyses once statistical interactions were detected.

Although the overall sample size was large, it is important to note that the number of IRF patient records and the number of SNF patient records was not equal. In other words, there was unbalanced data.[113] Fewer SNF records were available for analysis, and the smaller SNF sample size may have had an impact on the precision and variability of estimates for continuous variables, the confidence intervals for the odds ratios, as well as the regression estimates and diagnostics (e.g., multicollinearity).[113]

The large number of cases included in the study resulted in some analyses that found statistically significant results, but the regression coefficients showed very small effects. Some error would be expected in FIM ratings, but there are no guidelines that specify the amount of difference in FIM ratings that would be clinically important. In this study, differences of 2 or more motor FIM units were considered clinically important. This value was chosen based on previous research that compared FIM ratings of persons with disabilities and the amount

of help that these individuals required on a daily basis. [94-97] These studies found that an increase of between 3 and 5 (motor and cognitive) FIM units decreased the amount of daily help needed by about 30 minutes.

No treatment data were available for analysis in this study. Medicare regulations required that patients in IRFs receive 3 hours of therapy at least 5 days a week, but there were no Medicare guidelines for SNFs.

Another limitation of this study relates to the time frame of the FIM data collected relative to the onset of the hip fracture or stroke. In this study, the functional status data, the measures of severity and outcomes, were available only at the time of the rehabilitation admission and at the time of rehabilitation discharge. The timing of the admission data was a limitation because the time since the onset of the event (either stroke or hip fracture) varied by patient and the median onset times by setting were different. To attempt to control for this confounder, the time since onset to rehabilitation admission was used as the first covariate in the regression models.

The time between the onset of the condition and the discharge also varied by setting. The length of the rehabilitation stay was not used as a covariate since this was considered part of the rehabilitation treatment program.

An important concern for any observational study is the possibility that the research design, methods, or analyses included a flaw that resulted in biased results. As indicated above, the data included in this study were restricted to patients who were admitted to facilities that subscribed to UDSMR in 1996 and 1997. In addition, the number of records included in analyses was further reduced when records from UDSMR and MedPAR were linked. There may have been differences between the facilities that had linked data, and the facilities that could not be linked. Also, within each facility that had linked data, there may have been differences in the records that were linked and the records that were not linked. Analyses of the UDSMR data and the linked UDSMR/MedPAR data did not show any obvious signs of bias, although regression estimates did vary slightly.

With regard to the financial data reported in this study, it is important to acknowledge that it includes only Medicare Part A payments. This study did not include Medicare Part B payments, such as physician payments and payments for ancillary services. Physician payments, which would be expected to be higher for IRFs than for SNFs, and payments for ancillary services billed to Part B of Medicare for care provided to patients in SNFs were not available for analyses. Thus, the payment data do not represent total payments to providers from Medicare. Lui,[29] in analyzing 1990 Medicare claims, found that the mean charges to Medicare Part B for all beneficiaries (i.e., all diagnoses) during SNF

stays (both traditional SNF and SNF-based rehabilitation) was approximately $1,460.

Suggestions for Further Research

Comparing the outcomes and costs of rehabilitation care continues to be an important topic of health services researchers, and the types of post acute care under study have been expanded to include care provided by home health care agencies (HHA) as well as IRFs and SNFs.[115]

The introduction by Medicare of prospective payment systems in SNFs in 1998, Home Health Agencies in 2000 and IRFs in 2002 was expected to alter utilization patterns of post acute care, [28] and may affect patient outcomes and Medicare payments to facilities. Monitoring the access to post acute care, and the outcomes of care in these PPS settings will be important.

In addition to studies of utilization and outcomes of post acute care, researchers are also trying to identify why some rehabilitation programs achieve better outcomes -- more specifically, what aspect of the rehabilitation program (therapy intensity, total number of therapy treatments, role of physicians, nurses, psychologists, discharge planners, etc.) led to differences in the outcomes of patients.

With regard to the methods used in this study, 2 issues will be mentioned for consideration in the context of future research.

The first issue is related to the process of linking UDSMR and MedPAR patient records. This study linked records based on probabilistic record linkage by using 6 linkage variables: admission date, discharge date, age, ZIP code and race/ethnicity. In most cases, the percent of record pairs in which the data from the 2 sources agreed was greater than 90 percent for admission date, discharge date, age, and race/ethnicity. For the variable of ZIP code, among paired records, the data agreed about 86 percent of the time. Although not clearly stated in the MedPAR codebook, the ZIP code reported in the MedPAR data reflects the patient's residence after discharge (i.e., billing address). This is in contrast to the UDSMR ZIP code data, which is defined as the ZIP code of the patient's residence prior to the episode of care.

Therefore, for patients who were not discharged to their pre-hospital residence, there is a greater chance that the ZIP code data in the UDSMR and MedPAR records would not agree. If data for ZIP code did not agree, but data for all other linkage variables did agree, then the records were linked, and the records were included in the analyses. However, when data for ZIP code and one of the other linkage variables did not agree, then the record may have been less likely to be linked and included in analyses. This could have resulted in the removal of records in which the patients were not discharged to a community-based setting, and could have biased results toward the null.

Although this does not appear to have been a problem with this study, researchers interested in linking data from the IRF-PPS data collection instrument (i.e., the Inpatient Rehabilitation Facility Patient Assessment Instrument), which was based on the Uniform Data Set for Medical Rehabilitation, and MedPAR data in the future should probably not use ZIP code as a linkage variable.

Another important issue that relates to the methods used in this study was the selection of ICD-9-CM codes used to identify patients with stroke. In this study, only patients with ICD-9-CM codes indicating stroke or the late effects of a stroke were included. The median percent of records linked from the stroke databases was lower than the median percent of records linked in the hip fracture databases. A review of the unlinked MedPAR records found that hemiplegia (342.xx) was listed as a diagnosis in many of these records, but there was no diagnosis specifying the cause of the hemiplegia. According the ICD-9-CM coding guidelines, the Late Effects of Stroke code should be used to document sequelae of stroke. As noted by Reker et al., the absence of an agreed-upon definition of patients with stroke may lead to varying study results depending on the stroke selection criteria.[116]

Implications for Practice

The results of the current study would suggest that for Medicare fee-for-service patients with a recent hip fracture who need restorative care, treatment in a SNF-

based rehabilitation program is less costly for Medicare Part A, and patient outcomes are good. Although functional status was not different for the patients treated in IRFs and SNFs, a higher percentage of the patients treated in SNFs were discharged to the community for 3 of the 4 groups.

For Medicare fee-for-service patients with a recent stroke who need restorative care, treatment in an IRF was more costly for Medicare Part A than SNF-based rehabilitation care, but patients achieved better outcomes. For patients in Case-Mix Groups 101 to 107, those treated in IRFs were more likely to return to the community than patients treated in SNFs, although motor functional status was not different for the two rehabilitation settings. For patients in Case-Mix Groups 108 to 114 who were younger than 78, those treated in an IRF were more likely to be discharged to the community and to achieve greater motor independence than those patients treated in SNFs.

For patients in Case-Mix Groups 108 to 114 who were older than 77, the percentage of patients discharged to the community was not different for IRFs and SNFs, but patients treated in IRFs achieved greater motor independence at the time of discharge.

When considering both discharge destination and discharge motor function, patients with stroke who were treated in IRFs achieved better outcomes than patients treated in SNF-based programs.

The Medicare program has responsibilities to its beneficiaries and to taxpayers to be a prudent purchaser of health care services. This means that in setting policies, Medicare must try to balance access to services that result in the best outcomes for the beneficiaries against the cost of such services.

In considering practice implications, it is important to re-emphasize 4 issues: 1) this study focused on only one phase (i.e., the inpatient rehabilitation services component) of the patient's recovery following a hip fracture or stroke, because follow-up data were not available. 2) The SNF-based rehabilitation programs included in the study are not representative of all SNFs. The SNFs included in the study voluntarily collected and submitted FIM data to a national rehabilitation outcomes database in order to receive performance reports. 3) CMS does not distinguish SNFs that provided rehabilitation programs from traditional (i.e., standard) SNFs. 3) Since 1998, SNFs have been paid by Medicare under a per diem (i.e., daily) prospective payment system, and since 2002, IRFs have been paid by Medicare under a per-discharge prospective payment system. Clinical practices in IRFs and SNFs have probably changed with new Medicare PPS-related incentives.[28] It is not known whether these changes have affected patient outcomes or Medicare payments.

Given the issues described above, the study results suggest that the Medicare program may lower expenditures by directing patients with hip fracture for inpatient rehabilitation services to SNF-based programs rather than to IRFs, if

post-rehabilitation outcomes and costs are similar for patients discharged from both settings.

For patients with stroke, rehabilitation care in an IRF was more effective and more costly than SNF care. Additional research would be necessary to determine whether post-rehabilitation (i.e., follow-up) outcomes and Medicare reimbursement were different for patients treated in IRFs and SNFs.

Summary

The results of this study suggest that in 1996 and 1997 (i.e., prior to SNF PPS and IRF PPS) patients with hip fractures who received treatment in a SNF-based rehabilitation program that subscribed to UDSMR achieved comparable or better outcomes than patients treated in IRFs. However, Medicare Part A payments to IRFs were higher by 54 to 73 percent than payments to SNFs.

Among patients with stroke, those treated in IRFs achieved better outcomes, either an increased likelihood of a community discharge, or more independence with motor function, or both, than patients who were treated in SNFs.

Medicare Part A payments to IRFs for treatment of patients with stroke were between 79 and 117 percent higher than Part A payments to SNF-based rehabilitation programs.

Appendix A
Glossary of Terms

Glossary of Terms

Activities of daily living (ADL): Basic daily activities such as eating, grooming, bathing, transferring and dressing.[117]

Admission Cognitive FIM Rating: The functional assessment cognitive rating derived from administering the cognitive items of the FIM instrument (i.e., last five items). The FIM instrument was administered within 72 hours after admission. The five cognitive items of the FIM instrument are: Comprehension, Expression, Social Interaction, Problem Solving and Memory.[82]

Admission Motor FIM Rating: The baseline functional assessment motor rating derived from administering the motor items of the FIM instrument (i.e., first 13 items) at the time of admission to the rehabilitation program. The FIM instrument was administered within 72 hours after admission. The 13 motor FIM items are: Eating; Grooming; Bathing; Dressing – Upper Body; Dressing – Lower Body; Toileting; Bladder Management; Bowel Management; Transfers: Bed, Chair, Wheelchair; Transfers: Toilet; Transfers: Tub or Shower; Walk/Wheelchair; and Stairs.[82]

Agree: In the context of linkage theory, indicates the codes recorded for the corresponding linkage variables are the same in the records from the 2 sources, without regard to the match status of the records.[104]

Appropriateness: The degree to which the care provided is relevant to the patient's clinical needs, given the current state of knowledge.[118]

Benchmarking: A process of measuring a similar organization's product or service according to specified standards in order to compare it with and improve one's own product or service.[119]

Case mix: 1. The mix of cases, defined by age, sex, diagnoses, treatments, severity of illness, and so on, handled by a practitioner or hospital. Case mix is defined by: grouping patients (classification) according to these factors; and then determining the proportion of the total falling into each group. 2. The distribution and different types of patients cared for in a health care facility. The age, type of patient, type of illness or injury, source of payment, acuity, severity of illness, intensity of care needed, and diagnosis-specific makeup of a health service or program's workload determine and affect the mix of patients in a hospital or other health care facility. The type and frequency of patient admissions, reflecting the needs for different hospital resources. The types of patients defined by diagnosis, disease, procedure, method of payment, age. Case mix directly influences the length of stay, the intensity of care offered, and the cost and scope of the services provided by a hospital or other health program.[118]

Case-Mix Groups: A case-mix classification system that uses selected case attributes to derive predictions for such variables as cost, length of stay and discharge functional status. Used by Medicare in the IRF-PPS.[25]

Charges*:* In health care finance, prices assigned to units of service such as a visit to a physician or hospital*.* Charges for services may not be related to the actual costs of providing services. Methods by which charges are related to costs vary substantially from service to service and institution to institution.[118]

Community discharge: Discharge to a community-based setting, including a home (of the patient, relative or other person), transitional living setting, board and care setting, or assisted living residence.[82]

Comorbidity*:* A coexisting disease state.

Confounding factors: Intervening variables that distort the true relationship between/among the variables of interest. They are related to the outcome of interest, but extraneous to the study question and are non-randomly distributed among the groups being compared. They can hide a true correlation or give the appearance of a correlation when none actually exists.[120]

Glossary of Terms (cont'd)

Cost: 1. The total expense required for the provision of health services. 2. Actual expenses incurred for inpatients; inpatient care including all direct and indirect expenses; direct costs such as staff salary, plant maintenance, equipment, supplies, utilities; indirect costs such as mortgages, loan repayment, and cost of capital. 3. A monetary value applied to an asset or service obtained by an expenditure of cash or a commitment to make a future expenditure.[118]

Covariate: A variable that is possibly predictive of the outcome under study. A covariate may be of direct interest to the study or may be a confounding variable or effect modifier.[120]

Credentialing: In this study, it refers to a process of ensuring the reliability of FIM data. It includes a written test of FIM scoring skills.[81]

Data quality: The accuracy and completeness of data in the context of the analytic purposes for which they will be used.

Disability: Any restriction or lack of ability to perform an activity in a manner or within a range considered normal for a person of the same age, culture and education.[117]

Discharge Cognitive FIM Rating: The cognitive functional status of an individual at the time of discharge from the medical rehabilitation program. The Cognitive FIM Rating was calculated by summing the ratings of the 5 cognitive items. The Cognitive FIM Rating may range from 5 to 35, with a higher rating indicating more independence.[82]

Discharge Motor FIM Rating: The motor functional status of an individual at the time of discharge from the medical rehabilitation program. The Motor FIM Rating was calculated by summing the ratings of the 13 motor items. The Motor FIM Rating may range from 13 to 91, with a higher rating indicating more independence.[82]

East North Central Region: A census region that includes the States of Ohio, Indiana, Illinois, Michigan, Wisconsin.[12]

East South Central Region: A census region that includes the States of Arkansas, Louisiana, Oklahoma and Texas.[12]

Effectiveness: The extent to which a specific intervention, procedure, regimen, or service, when applied in routine circumstances, does what it is intended to do for a specific population.[120]

Glossary of Terms (cont'd)

Functional Independence Measure (FIM^{TM} instrument): A functional assessment instrument that includes 18 items that are each rated on a 7-level scale representing gradations from independent (7) to dependent (1) function.[82]

Functional status: An individual's actual performance of activities and tasks.

Impairment Group: The category that describes the primary anatomical defect, disease or psychological state for which the individual is receiving rehabilitation.[25]

Inpatient: An individual receiving care while being housed in a medical facility.[118]

Independence: The ability to perform a task without physical or cognitive assistance or supervision, within a reasonable amount of time.[82]

International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM): The classification in current use in the U.S. for coding diagnoses and procedures related to morbidity and mortality; for indexing medical records by diagnoses and procedures; for compiling organization statistics; and for submitting claims to third-party payers.[107]

Length of Stay: The number of days that an individual spends in a facility. It is calculated by subtracting the Admission Date from the Discharge Date.[82]

Link: In the context of record linkage theory, refers to the analytic decision made by the investigator about whether a record from one source and a record from another source refer to the same individual (or event). It may or may not reflect the true match status.[104]

Linkage variable: In the context of record linkage theory, refers to the variables (i.e., data field) from the 2 data sources (i.e., separate data files) that are equivalent, and whose data are compared.[104]

Managed care: A system of health care delivery and financing structured to encourage preventive and primary care through review of payment methodologies that make care providers responsible for the health of their patients and for the utilization of health care services.

Match: In the context of record linkage theory, refers to whether a pair of records from two separate data sources correspond to the same person, object or event, without regard for decisions made by the investigator.[104]

Glossary of Terms (cont'd)

Medicaid: A federal and state funded, state-administered program of medical assistance for people with low incomes.[118]

Medicare: A national health payment program for persons over 65 years of age and persons who are disabled.[118]

Medicare Part A: This part of the Medicare program covers the cost of hospital and related post-hospital services. Eligibility is normally based on prior payment of payroll taxes. Beneficiaries are responsible for an initial hospital deductible per spell of illness and co-payments for some services.[23]

Medicare Part B: This part of the Medicare program covers the cost of physician services, outpatient laboratory and X-ray tests, durable medical equipment, and certain other services. This voluntary program requires payment of a monthly premium, which covers about 25 percent of the program costs, with general revenues covering the rest. Beneficiaries are responsible for an annual deductible and coinsurance payments for most covered services.[23]

Middle Atlantic Region: A census region that includes the States of New York, New Jersey and Pennsylvania.[12]

Glossary of Terms (cont'd)

Mountain Region: A census region that includes the States of Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah and Nevada.[12]

New England Region: A census region that includes the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.[12]

Onset Days: The number of days from acute onset of the impairment to admission to the rehabilitation program.

Outcome: The ultimate impact of treatment on disease or trauma.[118]

Pacific Region: A census region that includes the States of Washington, Oregon, California, Alaska and Hawaii.[12]

Program interruption: A patient's transfer to another unit or facility (usually an acute care unit) and return to the rehabilitation program within 30 days or less, provided the patient does not have a new rehabilitation impairment.[82]

Prospective payment: Payment to a health care facility at a predetermined rate for treatment regardless of the costs of care for a specific individual patients.[121]

Rehabilitation services: Treatments received as part of a program to enhance functional ability. Rehabilitation services include medical and nursing care, rehabilitation therapies (i.e., OT, PT, or SLP), counseling sessions, recreational activities, and anything else prescribed to increase a patient's independence.[117]

Reimbursement: In health care finance, this is paying back monies expended to provide health care services; the process by which health care providers receive payment from a third-party payer for services rendered.[118]

Reliability: The ability of the indicator to identify both accurately and consistently the events it was designed to identify across multiple settings.

Skilled Nursing Facility (SNF): A type of nursing home recognized by the Medicare and Medicaid systems as meeting long-term health care needs for individuals who have the potential to function independently after a limited period of care. A multidisciplinary team guides health care and rehabilitation services, including skilled nursing care.

South Atlantic Region: A census region that includes the District of Columbia and the States of Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia and Florida.[12]

Stratification: A form of accounting for case mix differences across facilities that involves reporting data separately by subgroups. For example, data values may be reported for *each* CMG category (i.e., stratified by CMG) so that data may be compared at the CMG level.

Subacute: goal-oriented, comprehensive, inpatient care designed for an individual who has an acute illness, injury, or exacerbation of a disease process. It is rendered immediately after, or instead of, acute hospitalization to treat one or more specific, active, complex medical conditions or to administer one or more technically complex treatments in the context of a person's underlying long-term conditions and overall situations...Subacute care is generally more intensive than traditional nursing facility care and less intensive than acute inpatient care. It requires frequent (daily to weekly) patient assessment and review of the clinical course and treatment plan for a limited time period (several days to several months), until a condition is stabilized or a predetermined treatment course is completed.[32]

Subacute rehabilitation: a level of rehabilitative care designed to meet the needs of patients who medically and physically are too frail to participate in the rigors of a conventional inpatient physical rehabilitation program (i.e., 3 hours or more of daily therapy). Subacute rehabilitation also may be appropriate for patients who do not require intense multiple therapies but may have medical comorbidities and complicating factors that require the medical supervision of a physiatrist. Physicians usually visit patients in subacute rehabilitation two or three times per week, based on medical necessity……Subacute rehabilitation is comprehensive but less intense than comprehensive rehabilitation, depending on patient needs. It focuses on issues that promote recovery of functions that may have been impaired by a patient's illness or surgery.[32]

Time from Onset to Rehabilitation Admission: The number of days between the onset of the impairment and the admission to the rehabilitation program, usually reflective of the days spent in acute care.[81]

UDSMR Subscriber: A facility that has a written agreement with UDSMR to send patient data to UDSMR four times a year and receive quarterly data reports.[81]

West North Central Region: A census region that includes the States: Iowa, Minnesota, Missouri, North Dakota, South Dakota, Nebraska and Kansas.[12]

Appendix B
UDSMR Coding Sheet

Appendix C
Linkage Theory

Linkage Theory

The process of record linkage requires that an analytical decision be made about whether 2 records represent the same individual, object or event. The decision-making process of record linkage may be compared to the process by which a physician reviews results of a screening test and makes a decision about whether a patient does or does not have a disease. In record linkage, the match status of the 2 records (i.e., knowledge about whether the records represent the same individual) is unknown at the outset, just as the patient's true disease status is unknown to the physician ordering medical screening tests. In both situations, a decision is made that may be correct (e.g., matched records are linked; diagnosis for a patient with the disease) or may be incorrect (e.g., non-matched records are linked; wrong diagnosis for a patient).

Linkage theory terminology and parallel descriptions using screening test results are described in Table C.1 and Figure C.1.

Table C.1 Comparison of Terminology Used in Linkage Theory and Screening Tests

Linkage Theory		Screening Test Terminology
Term	**Definition**	
Match	The 2 records represent the same individual	True case of disease
Link	Decision to treat the 2 records as representing the same person (may or may not be a true match)	Test positive on screening (may or may not have the disease)
Agree	Values in the 2 records are the same	One of the screening criteria is positive, or one aspect of screening criteria is met.

Figure C.1 Comparison of Record Linkage Terms with Screening Test Results

	Match	Non-match
Linked	True positives	False positives
Not linked	False negatives	True negatives
	Records that should be linked	Records that should NOT be linked

	Disease	No Disease
Test positive	True positives	False positives
Test negative	False negatives	True negatives
	Patients who should be given diagnosis	Patients who should NOT be given diagnosis

Several methods have been used to link data records from 2 or more sources. *Deterministic linking* relies on exact agreement for all linking variables. *Probabilistic linking* is based on weighting the probabilities of agreement or disagreement (i.e., error rates) among the linking variables in the files. *Staged linking* is based on isolating groups of records having 1 or more variables in common, and then using probabilistic techniques within these groups to link records.[104, 105]

The *deterministic procedure* of record linkage assumes that there are no errors introduced when the data are collected, recorded or encoded (i.e., data entry), and that the variables selected for matching the 2 files agree exactly.[104, 105]

In contrast, *probabilistic linkage* assumes that there may be errors in the data, and that the record linkage algorithm will have a proper scientific base if it is based on the statistical properties of the errors that are likely to occur. The

agreement status of data for each linkage variable provides some evidence, either positive or negative, about the likelihood that the records represent the same individual. When evidence from each of the linkage variables is combined, a decision may be made about which record pairs should be linked, and which pairs should not be linked.[105]

The methodology for *probabilistic record linkage* recognizes that each linkage variable provides a unique level of evidence for or against linking records. Some of the assumptions underlying probabilistic record linkage theory[104, 105] are:

- Requiring perfect agreement on all linking variables could result in missing a significant number of matches. A pair of matching records will not agree perfectly on all linking variables because of data errors (e.g., transcription, encoding) and slight variations in the way some variables are defined.
- Some linkage variables provide information that is more useful than other linkage variables. For example, it would not be reasonable to sort the data records by the variable sex and declare that if sex agrees that the record pair represents the same individual. It would be reasonable to sort the data by a unique identifier such as Medicare number, and consider records in which the numbers agree as representing the same individual. Agreement on a linking variable that has many possible values, such as Medicare number or admission date, should carry more weight than agreement on another variable with fewer possible values, such as sex. Counting the number of

linkage variables in which the data agree does not recognize the unique contributions of each variable.

- Not all data disagreements between pair records provide the same amount of evidence that a match is incorrect. Disagreement of data for a variable that is almost always coded correctly in both files provides strong evidence against a match, while data disagreement for a variable that tends to be coded carelessly in 1 or both files may provide little evidence either way.
- For a given linking variable, the amount of evidence provided by an agreement varies depending on the frequency of occurrence of a particular value. For example, if 2 records agree on an age that is infrequent (e.g., 100 years of age), an event that is unlikely to occur by chance, the evidence is stronger than if the records agree on an age that occurs frequently.

Calculating the Marginal Contributions for Each Linkage Variable

As described above, probabilistic record linkage combines evidence from several linkage variables to determine whether a pair of records is likely a match. The process begins with determining the degree to which each linkage variables supports (or does not support) a match. The evidence from each linkage variable is then combined, and a composite score is derived that indicates the likelihood that the record pairs refer to the same individual or event.

If the value of the composite score is above an established threshold, the evidence would indicate the record pair are a match (i.e., the records do represent the same person or event), and should be linked. If the composite score value is below the threshold, the evidence would indicate the record pair is not a match (i.e., do not represent the same person or event), and should not be linked.

The process of calculating the marginal contribution for each linkage variable, and the composite score are described in detail below.

For each linkage variable, 2 probabilities are calculated. These probabilities are called *m* and *u* probabilities. The *m* probability represents the probability that data for a particular variable from the 2 data sources agree when the records are true matches (i.e., the records describe the same person or event). This probability is calculated as 1 minus the error rate of the variable. For example, in a database of matched records, if the sex code from the 2 data sources disagrees 5 percent of the time due to error, then the *m* probability for this variable is: 1 – 0.05 = 0.95. The more reliable the variable, the higher the value of the *m* probability will be.[105]

The *u* probability represents the probability that data for this variable agrees for non-matched records (i.e., by chance alone). There are many more possible unmatched pairs than matched pairs. For example, if a file contains 100 records,

there are 10,000 (100 x 100 = 10,000) possible record pairings, with 100 matches and 9,900 unmatched pairs. For a variable to be useful as a linkage variable, the *m* probability must always be greater than the *u* probability; when the *u* probability is greater than the *m* probability, chance agreement is more likely to occur than agreement in matched pairs. Such a variable would not discriminate well between matched and unmatched records.[105]

The probabilistic approach to record-linkage involves calculating a log-likelihood ratio based on the *m* and *u* probabilities for each linkage variable.

If data codes from the 2 sources for a variable agree, the marginal contribution for this variable will be a positive value and is computed using the following formula:

$$\log\left(\frac{m}{u}\right)$$

If the data codes from the 2 sources for a variable do ***not*** *agree*, the marginal contribution for the variable will be a negative value and will be calculated using the following formula:

$$\log\left(\frac{(1-m)}{(1-u)}\right)$$

Calculating the Composite Score

When each pair of records is compared, the marginal contribution for each linkage variable is identified based on whether the data values in the 2 source files agree or disagree. The marginal contributions for all linkage variables are then summed to derive a composite score. The composite score represents the log odds that the 2 records are a match.[104, 105]

When data for linkage variables agree, the composite score increases, and when data disagree, the composite score decreases. The higher the composite score, the greater the odds that the records are a match.

An example follows that demonstrates the process of calculating the composite score.

For the variable sex, the *m* probability is 0.99 and the *u* probability is 0.51. For the variable ZIP code, the *m* probability is .87 and the *u* probability is 0.05. A comparison of 2 hypothetical records with the following data: 1) a female living in ZIP code area 14214 and 2) a female living in ZIP code 14072, would result in a composite score of:

$$\left[\log\left(\frac{0.99}{0.51}\right)\right]+\left[\log\left(\frac{1-0.87}{1-0.05}\right)\right]=0.29-0.86=-0.57$$

If one record indicated that the person was a male, and the second record reported the sex as female, but the ZIP code in both records were the same, then the composite score would be:

$$\left[\log\left(\frac{1-0.99}{1-0.51}\right)\right]+\left[\log\left(\frac{0.87}{0.05}\right)\right]=-1.69+1.24=-0.45$$

In Carter's 1997 study[103] that linked the UDSMR's comprehensive medical rehabilitation data with MedPAR data using this methodology, Carter matched 85.6 percent of cases.

Appendix D
Linkage Tables

Table D.1 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1996

Difference	N (n=13,912)	Probability the records match | difference (n = 13,912)	Probability the records do not match | difference (n = 1,461)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	13,414	.9642	.0445	21.6723	1.3
1	226	.0162	.0726	.2239	-0.6
2	78	.0056	.0705	.0795	-1.1
3	29	.0021	.0808	.0258	-1.6
4	23	.0017	.0650	.0254	-1.6
5	23	.0017	.0486	.0340	-1.5
6	19	.0014	.0513	.0266	-1.6
7	8	.0006	.0520	.0111	-2.0
8	7	.0005	.0561	.0090	-2.0
9	9	.0006	.0493	.0131	-1.9
10	16	.0012	.0370	.0311	-1.5
11	10	.0007	.0479	.0150	-1.8
12	8	.0006	.0363	.0159	-1.8
13	3	.0002	.0363	.0059	-2.2
14	8	.0006	.0363	.0159	-1.8
15	1	.0001	.0281	.0026	-2.6
16	2	.0001	.0192	.0075	-2.1
17	7	.0005	.0267	.0188	-1.7
18	1	.0001	.0192	.0038	-2.4
19	1	.0001	.0164	.0044	-2.4
20	3	.0002	.0151	.0143	-1.8
21	3	.0002	.0144	.0150	-1.8
22	0*	.0001	.0068	.0105	-2.0
23	2	.0001	.0089	.0162	-1.8
24	1	.0001	.0075	.0095	-2.0
25	1	.0001	.0041	.0175	-1.8
26	0*	.0001	.0068	.0105	-2.0
27	0*	.0001	.0034	.0210	-1.7
28	0*	.0001	.0027	.0263	-1.6
29	0*	.0001	.0014	.0525	-1.3
30	1	.0001	.0021	.0350	-1.5
31	0*	.0001	.0014	.0525	-1.3
32	1	.0001	.0034	.0210	-1.7
33	1	.0001	.0027	.0263	-1.6
34	0*	.0001	.0034	.0210	-1.7
35	0*	.0001	.0021	.0350	-1.5

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.2 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1996

Difference	N (n=13,912)	Probability the records match | difference (n=13,912)	Probability the records do not match | difference (n =1,484)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	13,767	.9896	.0081	122.3777	2.1
1	61	.0044	.0047	.9296	0.0
2	13	.0009	.0054	.1733	-0.8
3	13	.0009	.0061	.1541	-0.8
4	7	.0005	.0007	.7467	-0.1
5	10	.0007	.0040	.1778	-0.8
6	3	.0002	.0027	.0800	-1.1
7	2	.0001	.0101	.0142	-1.8
8	2	.0001	.0074	.0194	-1.7
9	0*	.0001	.0047	.0212	-1.7
10	12	.0009	.0040	.2133	-0.7
11	2	.0001	.0047	.0305	-1.5
12	0*	.0001	.0047	.0212	-1.7
13	0*	.0001	.0047	.0212	-1.7
14	3	.0002	.0081	.0267	-1.6
15	0*	.0001	.0047	.0212	-1.7
16	1	.0001	.0040	.0178	-1.8
17	1	.0001	.0054	.0133	-1.9
18	3	.0002	.0007	.3200	-0.5
19	1	.0001	.0034	.0213	-1.7
20	1	.0001	.0061	.0119	-1.9
21	1	.0001	.0054	.0133	-1.9
22	0*	.0001	.0088	.0114	-1.9
23	0*	.0001	.0027	.0371	-1.4
24	2	.0001	.0067	.0213	-1.7
25	0*	.0001	.0040	.0247	-1.6
26	0*	.0001	.0054	.0186	-1.7
27	2	.0001	.0047	.0305	-1.5
28	2	.0001	.0094	.0152	-1.8
29	0*	.0001	.0067	.0148	-1.8
30	1	.0001	.0040	.0178	-1.8
31	1	.0001	.0047	.0152	-1.8
32	0*	.0001	.0047	.0212	-1.7
33	0*	.0001	.0081	.0124	-1.9
34	1	.0001	.0074	.0097	-2.0
35	0*	.0001	.0108	.0093	-2.0

N refers to the number of cases; | , given; Pr, probability

*When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.3 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1996

Difference	N (n=13,912)	Probability the records match | difference (n=13,912)	Probability the records do not match | difference (n = 1,484)	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	13,679	.9833	.0108	91.1966	2.0
1	117	.0084	.0061	1.3867	0.1
2	18	.0013	.0013	.9600	0.0
3	10	.0007	.0074	.0970	-1.0
4	13	.0009	.0027	.3467	-0.5
5	6	.0004	.0027	.1600	-0.8
6	7	.0005	.0061	.0830	-1.1
7	11	.0008	.0040	.1956	-0.7
8	2	.0001	.0054	.0267	-1.6
9	3	.0002	.0061	.0356	-1.4
10	11	.0008	.0034	.2347	-0.6
11	4	.0003	.0034	.0853	-1.1
12	2	.0001	.0040	.0356	-1.4
13	3	.0002	.0074	.0291	-1.5
14	2	.0001	.0081	.0178	-1.8
15	2	.0001	.0061	.0237	-1.6
16	2	.0001	.0054	.0267	-1.6
17	1	.0001	.0034	.0213	-1.7
18	5	.0004	.0054	.0667	-1.2
19	1	.0001	.0047	.0152	-1.8
20	2	.0001	.0034	.0427	-1.4
21	1	.0001	.0088	.0082	-2.1
22	0*	.0001	.0054	.0186	-1.7
23	0*	.0001	.0027	.0371	-1.4
24	0*	.0001	.0081	.0124	-1.9
25	0*	.0001	.0047	.0212	-1.7
26	0*	.0001	.0054	.0186	-1.7
27	1	.0001	.0034	.0213	-1.7
28	0*	.0001	.0115	.0087	-2.1
29	0*	.0001	.0054	.0186	-1.7
30	3	.0002	.0007	.3200	-0.5
31	1	.0001	.0047	.0152	-1.8
32	1	.0001	.0034	.0213	-1.7
33	1	.0001	.0054	.0133	-1.9
34	0*	.0001	.0067	.0148	-1.8
35	0*	.0001	.0054	.0186	-1.7

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.4 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1996

Variable	Number of errors in matched records	Prob. data agree in matched records	Number of errors in randomly linked records	Prob. data agree in randomly linked records	Ratio: match | agree not a match | agree	Log of Ratio: Marginal Contribution
Zip code	1,682 (n = 13,251)	87.3	100 (n = 1,461)	6.8	12.86	+ 1.1
Sex	139 (n = 13,909)	99.0	966 (n = 1,484)	65.1	1.52	+ 0.2
Race	400 (n = 13,654)	97.1	1295 (n = 1,463)	88.5	1.10	+ 0.1

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.5 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1996

Variable	Number of errors in matched records	Prob. data disagree in matched records	Number of errors in randomly linked records	Prob. data disagree in randomly linked Records	Ratio: disagree| match disagree| random	Log of Ratio: Marginal Contribution
Zip code	1,682 (n = 13,251)	12.7	100 (n = 1,461)	93.2	0.14	- 0.9
Sex	139 (n = 13,909)	1.0	966 (n = 1,484)	34.9	0.03	- 1.6
Race	400 (n = 13,654)	2.9	1295 (n = 1,463)	11.5	0.26	- 0.6

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.6 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1996

Difference	N (n = 2,513)	Probability the records match | difference (n = 2,513)	Probability the records do not match | difference n=750	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	2,424	.9646	.0440	21.9224	1.3
1	37	.0147	.0787	.1872	-0.7
2	6	.0024	.0773	.0309	-1.5
3	9	.0036	.0667	.0537	-1.3
4	5	.0020	.0587	.0339	-1.5
5	4	.0016	.0533	.0298	-1.5
6	3	.0012	.0693	.0172	-1.8
7	4	.0016	.0533	.0298	-1.5
8	2	.0008	.0493	.0161	-1.8
9	3	.0012	.0467	.0256	-1.6
10	3	.0012	.0373	.0320	-1.5
11	1	.0004	.0280	.0142	-1.8
12	3	.0012	.0373	.0320	-1.5
13	1	.0004	.0427	.0093	-2.0
14	1	.0004	.0333	.0119	-1.9
15	1	.0004	.0307	.0130	-1.9
16	1	.0004	.0253	.0157	-1.8
17	0*	.0004	.0200	.0200	-1.7
18	0*	.0004	.0213	.0188	-1.7
19	0*	.0004	.0173	.0231	-1.6
20	1	.0004	.0267	.0149	-1.8
21	0*	.0004	.0067	.0600	-1.2
22	1	.0004	.0107	.0373	-1.4
23	2	.0008	.0040	.1990	-0.7
24	1	.0004	.0080	.0497	-1.3
25	0*	.0004	.0053	.0750	-1.1
26	0*	.0004	.0040	.1000	-1.0
27	0*	.0004	.0053	.0750	-1.1
28	0*	.0004	.0027	.1500	-0.8
29	0*	.0004	.0040	.1000	-1.0
30	0*	.0004	.0053	.0750	-1.1
31	0*	.0004	.0013	.3077	-0.5
32	0*	.0004	.0040	.1000	-1.0
33	0*	.0004	.0027	.1500	-0.8
34	0*	.0004	.0013	.3000	-0.5
35	0*	.0004	.0027	.1500	-0.8

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.7 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1996

Difference	N (n = 2,513)	Probability the records match | difference (n = 2,513)	Probability the records do not match | difference (n = 752)	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	2,477	.9857	.0160	61.7689	1.8
1	20	.0080	.0066	1.1970	0.1
2	4	.0016	.0013	1.1970	0.1
3	3	.0012	.0066	.1795	-0.7
4	2	.0008	.0040	.1990	-0.7
5	0*	.0004	.0027	.1504	-0.8
6	1	.0004	.0053	.0748	-1.1
7	0*	.0004	.0040	.1003	-1.0
8	3	.0012	.0066	.1795	-0.7
9	0*	.0004	.0040	.1003	-1.0
10	1	.0004	.0040	.0997	-1.0
11	1	.0004	.0080	.0499	-1.3
12	0*	.0004	.0040	.1000	-1.0
13	0*	.0004	.0027	.1504	-0.8
14	0*	.0004	.0080	.0501	-1.3
15	0*	.0004	.0053	.0752	-1.1
16	0*	.0004	.0040	.1003	-1.0
17	1	.0004	.0053	.0748	-1.1
18	0*	.0004	.0040	.1000	-1.0
19	0*	.0004	.0040	.1003	-1.0
20	0*	.0004	.0120	.0334	-1.5
21	0*	.0004	.0066	.0602	-1.2
22	0*	.0004	.0066	.0602	-1.2
23	0*	.0004	.0013	.3008	-0.5
24	0*	.0004	.0040	.1003	-1.0
25	0*	.0004	.0053	.0752	-1.1
26	0*	.0004	.0080	.0501	-1.3
27	0*	.0004	.0106	.0376	-1.4
28	0*	.0004	.0080	.0501	-1.3
29	0*	.0004	.0027	.1504	-0.8
30	0*	.0004	.0066	.0602	-1.2
31	0*	.0004	.0066	.0602	-1.2
32	0*	.0004	.0027	.1504	-0.8
33	0*	.0004	.0080	.0501	-1.3
34	0*	.0004	.0053	.0752	-1.1
35	0*	.0004	.0080	.0501	-1.3

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.8 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1996

Difference	N (n= 2,513)	Probability the records match | difference (n= 2,513)	Probability the records do not match | difference (n=752)	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	2,372	.9439	.0106	88.7258	1.9
1	53	.0211	.0066	3.1720	0.5
2	8	.0032	.0040	.7980	-0.1
3	11	.0044	.0013	3.3671	0.5
4	3	.0012	.0027	.4489	-0.3
5	7	.0028	.0053	.5237	-0.3
6	2	.0008	.0040	.1995	-0.7
7	4	.0016	.0106	.1496	-0.8
8	3	.0012	.0066	.1795	-0.7
9	2	.0008	.0040	.1995	-0.7
10	3	.0012	.0040	.2992	-0.5
11	2	.0008	.0066	.1197	-0.9
12	1	.0004	.0013	.3061	-0.5
13	3	.0012	.0066	.1795	-0.7
14	4	.0016	.0027	.5985	-0.2
15	2	.0008	.0027	.2992	-0.5
16	1	.0004	.0027	.1496	-0.8
17	0*	.0004	.0013	.3077	-0.5
18	1	.0004	.0027	.1496	-0.8
19	2	.0008	.0066	.1197	-0.9
20	2	.0008	.0040	.1995	-0.7
21	2	.0008	.0040	.1995	-0.7
22	0*	.0004	.0040	.1003	-1.0
23	1	.0004	.0027	.1496	-0.8
24	1	.0004	.0106	.0374	-1.4
25	1	.0004	.0066	.0598	-1.2
26	0*	.0004	.0040	.1003	-1.0
27	0*	.0004	.0080	.0501	-1.3
28	1	.0004	.0053	.0748	-1.1
29	0*	.0004	.0040	.1003	-1.0
30	0*	.0004	.0040	.1003	-1.0
31	0*	.0004	.0013	.3008	-0.5
32	0*	.0004	.0027	.1504	-0.8
33	1	.0004	.0027	.1496	-0.8
34	1	.0004	.0027	.1496	-0.8
35	0*	.0004	.0066	.0602	-1.2

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.9 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1996

Variable	Number of errors in matched records	Prob. data agree in matched records	Number of errors in randomly linked records	Prob. data agree in randomly linked records	Ratio: match | agree not a match | agree	Log of Ratio: Marginal Contribution
Zip code	339 (n = 2,458)	86.2	58 (n = 741)	7.8	11.01	+ 1.0
Sex	23 (n = 2,513)	99.1	519 (n = 752)	69.0	1.44	+ 0.2
Race	28 (n = 2,481)	98.9	709 (n = 741)	95.7	1.03	+ 0.1

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.10 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1996

Variable	Number of errors in matched records	Prob. data disagree in matched records	Number of errors in randomly linked records	Prob. data disagree in randomly linked Records	Ratio: disagree| match disagree| random	Log of Ratio: Marginal Contribution
Zip code	339 (n = 2,458)	13.8	58 (n = 741)	92.2	0.15	- 0.8
Sex	23 (n = 2,513)	0.9	519 (n = 752)	31.0	0.03	- 1.5
Race	28 (n = 2,481)	1.1	709 (n = 741)	4.3	0.26	- 0.6

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.11 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1997

Difference	N (n=13,247)	Probability the records match | difference (n=13,247)	Probability the records do not match | difference (n = 819)	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	12,835	.9689	.0232	41.7629	1.6
1	186	.0140	.0708	.1983	-0.7
2	51	.0038	.0586	.0657	-1.2
3	36	.0027	.0549	.0495	-1.3
4	22	.0017	.0672	.0247	-1.6
5	15	.0011	.0586	.0202	-1.7
6	15	.0011	.0684	.0166	-1.8
7	6	.0005	.0574	.0079	-2.1
8	12	.0009	.0440	.0206	-1.7
9	10	.0008	.0586	.0129	-1.9
10	19	.0014	.0440	.0326	-1.5
11	4	.0003	.0354	.0085	-2.1
12	1	.0001	.0476	.0016	-2.8
13	5	.0008	.0464	.0172	-1.8
14	1	.0001	.0317	.0024	-2.6
15	2	.0002	.0256	.0059	-2.2
16	3	.0002	.0183	.0124	-1.9
17	1	.0001	.0122	.0062	-2.2
18	2	.0002	.0330	.0046	-2.3
19	2	.0002	.0183	.0083	-2.1
20	3	.0002	.0110	.0206	-1.7
21	1	.0001	.0183	.0041	-2.4
22	1	.0001	.0171	.0044	-2.4
23	1	.0001	.0134	.0056	-2.2
24	0*	.0001	.0085	.0089	-2.1
25	1	.0001	.0061	.0124	-1.9
26	0*	.0001	.0024	.0315	-1.5
27	0*	.0001	.0049	.0154	-1.8
28	0*	.0001	.0049	.0154	-1.8
29	1	.0001	.0037	.0204	-1.7
30	0*	.0001	.0037	.0204	-1.7
31	0*	.0001	.0100	.0075	-2.1
32	0*	.0001	.0037	.0204	-1.7
33	0*	.0001	.0012	.0629	-1.2
34	0*	.0001	.0049	.0154	-1.8
35	0*	.0001	.0024	.0315	-1.5

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.12 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1997

Difference	N (n=13,247)	Probability the records match | difference (n=13,247)	Probability the records do not match | difference (n = 839)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	13,113	.9899	.0083	119.2632	2.1
1	37	.0028	.0071	.3934	-0.4
2	14	.0011	.0012	.8807	-0.1
3	11	.0008	.0012	.6920	-0.2
4	16	.0012	.0024	.5033	-0.3
5	9	.0007	.0071	.0957	-1.0
6	3	.0002	.0071	.0319	-1.5
7	1	.0001	.0060	.0126	-1.9
8	5	.0003	.0060	.0629	-1.2
9	2	.0002	.0048	.0315	-1.5
10	6	.0005	.0095	.0477	-1.3
11	4	.0003	.0048	.0629	-1.2
12	1	.0001	.0083	.0091	-2.0
13	1	.0001	.0095	.0079	-2.1
14	3	.0002	.0012	.1887	-0.7
15	0*	.0001	.0060	.0126	-1.9
16	1	.0001	.0060	.0126	-1.9
17	0*	.0001	.0048	.0157	-1.8
18	1	.0001	.0060	.0126	-1.9
19	0*	.0001	.0048	.0157	-1.8
20	1	.0001	.0060	.0126	-1.9
21	1	.0001	.0083	.0091	-2.0
22	1	.0001	.0095	.0079	-2.1
23	2	.0002	.0083	.0181	-1.7
24	0*	.0001	.0071	.0106	-2.0
25	0*	.0001	.0060	.0126	-1.9
26	0*	.0001	.0012	.0629	-1.2
27	1	.0001	.0036	.0210	-1.7
28	0*	.0001	.0083	.0091	-2.0
29	0*	.0001	.0048	.0157	-1.8
30	0*	.0001	.0036	.0210	-1.7
31	2	.0002	.0036	.0419	-1.4
32	1	.0001	.0060	.0126	-1.9
33	0*	.0001	.0083	.0091	-2.0
34	0*	.0001	.0024	.0315	-1.5
35	1	.0001	.0095	.0079	-2.1

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.13 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1997

Difference	N (n=13,247)	Probability the records match | difference (n=13,247)	Probability the records do not match | difference (n = 839)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	12,997	.9811	.0083	118.2082	2.1
1	139	.0105	.0048	2.1860	0.3
2	20	.0015	.0048	.3145	-0.5
3	18	.0014	.0036	.3774	-0.4
4	7	.0005	.0060	.0881	-1.1
5	7	.0005	.0012	.4404	-0.4
6	6	.0005	.0048	.0944	-1.0
7	3	.0002	.0072	.0315	-1.5
8	7	.0005	.0036	.1468	-0.8
9	3	.0002	.0036	.0629	-1.2
10	11	.0008	.0072	.1153	-0.9
11	0*	.0001	.0060	.0126	-1.9
12	3	.0002	.0036	.0629	-1.2
13	3	.0002	.0060	.0377	-1.4
14	3	.0002	.0048	.0472	-1.3
15	2	.0002	.0120	.0126	-1.9
16	3	.0002	.0048	.0472	-1.3
17	0*	.0001	.0060	.0126	-1.9
18	1	.0001	.0072	.0105	-2.0
19	0*	.0001	.0036	.0210	-1.7
20	2	.0002	.0083	.0182	-1.7
21	1	.0001	.0036	.0210	-1.7
22	0*	.0001	.0048	.0157	-1.8
23	1	.0001	.0095	.0079	-2.1
24	0*	.0001	.0048	.0157	-1.8
25	0*	.0001	.0060	.0126	-1.9
26	1	.0001	.0036	.0210	-1.7
27	0*	.0001	.0083	.0091	-2.0
28	2	.0002	.0048	.0315	-1.5
29	0*	.0003	.0155	.0049	-2.3
30	1	.0001	.0036	.0210	-1.7
31	1	.0001	.0072	.0105	-2.0
32	0*	.0001	.0060	.0126	-1.9
33	0*	.0001	.0060	.0126	-1.9
34	0*	.0001	.0024	.0315	-1.5
35	0*	.0001	.0048	.0157	-1.8

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.14 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1997

Variable	Number of errors in matched records	Prob. data agree in matched records	Number of errors in randomly linked records	Prob. data agree in randomly linked records	Ratio: match | agree not a match | agree	Log of Ratio: Marginal Contribution
Zip code	1,648 (n = 12,859)	87.2	58 (n = 801)	7.2	12.11	+ 1.1
Sex	152 (n = 13,573)	98.9	543 (n = 839)	64.7	1.53	+ 0.2
Race	376 (n = 13,247)	97.2	762 (n = 835)	91.3	1.06	+ 0.1

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.15 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Inpatient Rehabilitation Facilities in 1997

Variable	Number of errors in matched records	Prob. data disagree in matched records	Number of errors in randomly linked records	Prob. data disagree in randomly linked Records	Ratio: disagree| match disagree| random	Log of Ratio: Marginal Contribution
Zip code	1,648 (n = 12,859)	12.8	58 (n = 801)	92.8	0.14	- 0.9
Sex	152 (n = 13,573)	1.1	543 (n = 839)	35.3	0.03	- 1.5
Race	376 (n = 13,247)	2.8	762 (n = 835)	8.7	0.32	- 0.5

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.16 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1997

Difference	N (n = 3,127)	Probability the records match | difference (n=3,127)	Probability the records do not match | difference (n= 1,057)	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	3,034	.9703	.0560	17.33	1.2
1	45	.0144	.0878	.16	-0.8
2	11	.0035	.0637	.06	-1.3
3	10	.0032	.0820	.04	-1.4
4	1	.0003	.0724	.00	-2.4
5	7	.0022	.0694	.03	-1.5
6	4	.0013	.0646	.02	-1.7
7	3	.0010	.0589	.02	-1.8
8	1	.0003	.0434	.01	-2.1
9	0*	.0003	.0415	.01	-2.1
10	6	.0019	.0444	.04	-1.4
11	2	.0006	.0434	.01	-1.8
12	1	.0003	.0328	.01	-2.0
13	0*	.0003	.0261	.01	-1.9
14	0*	.0003	.0174	.02	-1.7
15	0*	.0003	.0347	.01	-2.0
16	1	.0003	.0135	.02	-1.6
17	1	.0003	.0203	.02	-1.8
18	0*	.0003	.0241	.01	-1.9
19	0*	.0003	.0154	.02	-1.7
20	0*	.0003	.0145	.02	-1.7
21	0*	.0003	.0116	.03	-1.6
22	0*	.0003	.0106	.03	-1.5
23	0*	.0003	.0068	.05	-1.3
24	0*	.0003	.0087	.04	-1.4
25	0*	.0003	.0068	.05	-1.3
26	0*	.0003	.0058	.06	-1.3
27	0*	.0003	.0019	.17	-0.8
28	0*	.0003	.0019	.17	-0.8
29	0*	.0003	.0039	.08	-1.1
30	0*	.0003	.0039	.08	-1.1
31	0*	.0003	.0010	.32	-0.5
32	0*	.0003	.0010	.32	-0.5
33	0*	.0003	.0019	.17	-0.8
34	0*	.0003	.0019	.17	-0.8
35	0*	.0003	.0029	.11	-1.0

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.17 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1997

Difference	N (n = 3,127)	Probability the records match | difference (n = 3,127)	Probability the records do not match | difference (n = 1,057)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	3,010	.9626	.0180	53.4769	1.7
1	88	.0281	.0057	4.9372	0.7
2	8	.0026	.0058	.4411	-0.4
3	5	.0016	.0038	.4208	-0.4
4	1	.0003	.0095	.0337	-1.5
5	2	.0006	.0076	.0842	-1.1
6	0*	.0003	.0085	.0353	-1.5
7	1	.0003	.0095	.0337	-1.5
8	0*	.0003	.0066	.0455	-1.3
9	1	.0003	.0076	.0421	-1.4
10	2	.0006	.0066	.0969	-1.0
11	0*	.0003	.0066	.0455	-1.3
12	0*	.0003	.0057	.0526	-1.3
13	0*	.0003	.0085	.0353	-1.5
14	0*	.0003	.0095	.0316	-1.5
15	0*	.0003	.0057	.0526	-1.3
16	0*	.0003	.0047	.0638	-1.2
17	0*	.0003	.0047	.0638	-1.2
18	0	.0003	.0057	.0526	-1.3
19	1	.0003	.0028	.1142	-0.9
20	1	.0003	.0085	.0376	-1.4
21	0*	.0003	.0066	.0455	-1.3
22	1	.0003	.0038	.0842	-1.1
23	0*	.0003	.0057	.0526	-1.3
24	1	.0003	.0047	.0680	-1.2
25	0*	.0003	.0047	.0638	-1.2
26	0*	.0003	.0038	.0789	-1.1
27	0*	.0003	.0028	.1071	-1.0
28	0*	.0003	.0114	.0263	-1.6
29	1	.0003	.0057	.0561	-1.3
30	2	.0006	.0028	.2284	-0.6
31	0*	.0003	.0047	.0638	-1.2
32	0*	.0003	.0076	.0395	-1.4
33	0*	.0003	.0047	.0638	-1.2
34	1	.0003	.0095	.0337	-1.5
35	0*	.0003	.0047	.0638	-1.2

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.18 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1997

Difference	N (n = 3,021)	Probability the records match | difference (n = 3,021)	Probability the records do not match | difference (n= 1,057)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	2,760	.9136	.0123	74.28	1.9
1	105	.0348	.0114	3.05	0.5
2	15	.0050	.0104	.48	-0.3
3	17	.0056	.0057	.99	0.0
4	11	.0036	.0019	1.92	0.3
5	12	.0040	.0019	2.09	0.3
6	7	.0023	.0038	.61	-0.2
7	15	.0050	.0066	.75	-0.1
8	3	.0010	.0085	.12	-0.9
9	6	.0020	.0019	1.05	0.0
10	7	.0023	.0019	1.22	0.1
11	3	.0010	.0028	.35	-0.5
12	4	.0013	.0038	.35	-0.5
13	2	.0007	.0095	.07	-1.2
14	1	.0003	.0038	.09	-1.1
15	6	.0020	.0047	.42	-0.4
16	1	.0003	.0047	.07	-1.2
17	4	.0013	.0057	.23	-0.6
18	1	.0003	.0019	.17	-0.8
19	2	.0007	.0057	.12	-0.9
20	4	.0013	.0076	.17	-0.8
21	1	.0003	.0047	.07	-1.2
22	2	.0007	.0057	.12	-0.9
23	0*	.0003	.0038	.09	-1.1
24	1	.0003	.0066	.05	-1.3
25	1	.0003	.0076	.04	-1.4
26	1	.0003	.0085	.04	-1.4
27	4	.0013	.0114	.12	-0.9
28	2	.0007	.0066	.10	-1.0
29	2	.0007	.0019	.35	-0.5
30	1	.0003	.0057	.06	-1.2
31	2	.0007	.0038	.17	-0.8
32	1	.0003	.0038	.09	-1.1
33	0*	.0003	.0066	.05	-1.3
34	0*	.0003	.0076	.04	-1.4
35	1	.0003	.0057	.06	-1.2

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.19 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1997

Variable	Number of errors in matched records	Prob. data agree in matched records	Number of errors in randomly linked records	Prob. data agree in randomly linked records	Ratio: match | agree not a match | agree	Log of Ratio: Marginal Contribution
Zip code	488 (n = 2,972)	83.6	69 (n = 891)	7.7	10.8	+ 1.0
Sex	37 (n = 3,127)	98.8	345 (n = 1,057)	32.6	1.47	+ 0.2
Race	39 (n = 3,087)	98.7	59 (n = 1047)	94.4	1.05	+ 0.1

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.20 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Hip Fracture Treated in Skilled Nursing Facilities in 1997

Variable	Number of errors in matched records	Prob. data disagree in matched records	Number of errors in randomly linked records	Prob. data disagree in randomly linked Records	Ratio: disagree| match disagree| random	Log of Ratio: Marginal Contribution
Zip code	488 (n = 2,972)	16.4	69 (n = 891)	92.3	0.18	- 0.8
Sex	37 (n = 3,127)	1.2	345 (n = 1,057)	67.4	0.04	- 1.4
Race	39 (n = 3,087)	1.3	59 (n = 1047)	5.6	0.22	- 0.7

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.21 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1996

Difference	N (n =34,952)	Probability the records match | difference (n =34,952)	Probability the records do not match | difference (n=1,536)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	33,762	.9660	.0221	43.6384	1.6
1	534	.0153	.0638	.2395	-0.6
2	177	.0051	.0579	.0875	-1.1
3	95	.0027	.0566	.0480	-1.3
4	54	.0015	.0605	.0255	-1.6
5	52	.0015	.0443	.0336	-1.5
6	39	.0011	.0488	.0229	-1.6
7	32	.0009	.0475	.0193	-1.7
8	28	.0008	.0449	.0178	-1.7
9	21	.0006	.0339	.0177	-1.8
10	48	.0014	.0378	.0364	-1.4
11	10	.0003	.0404	.0071	-2.1
12	8	.0002	.0397	.0058	-2.2
13	9	.0003	.0228	.0113	-1.9
14	9	.0003	.0267	.0096	-2.0
15	5	.0001	.0280	.0051	-2.3
16	5	.0001	.0221	.0065	-2.2
17	5	.0001	.0228	.0063	-2.2
18	5	.0001	.0293	.0049	-2.3
19	4	.0001	.0221	.0052	-2.3
20	12	.0003	.0163	.0211	-1.7
21	3	.0001	.0221	.0039	-2.4
22	3	.0001	.0150	.0057	-2.2
23	1	.0000	.0163	.0018	-2.8
24	0*	.0000	.0130	.0008	-3.1
25	3	.0001	.0143	.0060	-2.2
26	0*	.0000	.0124	.0008	-3.1
27	4	.0001	.0098	.0117	-1.9
28	0*	.0000	.0078	.0013	-2.9
29	0*	.0000	.0124	.0008	-3.1
30	5	.0001	.0137	.0105	-2.0
31	1	.0000	.0065	.0044	-2.4
32	0*	.0000	.0052	.0019	-2.7
33	1	.0000	.0046	.0063	-2.2
34	1	.0000	.0052	.0055	-2.3
35	0*	.0000	.0052	.0019	-2.7

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.22 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1996

Difference	N (n=34,953)	Probability the records match | difference (n=34,953)	Probability the records do not match | difference (n = 1,559)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	34,556	.9886	.0032	308.9506	2.5
1	99	.0028	.0090	.3147	-0.5
2	19	.0005	.0032	.1699	-0.8
3	11	.0003	.0058	.0543	-1.3
4	2	.0001	.0038	.0151	-1.8
5	1	.00003	.0064	.0045	-2.3
6	1	.00003	.0038	.0075	-2.1
7	3	.0001	.0032	.0268	-1.6
8	1	.00003	.0071	.0040	-2.4
9	0	.00003	.0032	.0089	-2.0
10	2	.0001	.0045	.0127	-1.9
11	0*	.00003	.0032	.0089	-2.0
12	1	.00003	.0032	.0089	-2.0
13	0*	.00003	.0051	.0056	-2.3
14	0*	.00003	.0058	.0049	-2.3
15	0*	.00003	.0064	.0045	-2.3
16	0*	.00003	.0038	.0075	-2.1
17	0*	.00003	.0019	.0151	-1.8
18	0*	.00003	.0064	.0045	-2.3
19	0*	.00003	.0045	.0064	-2.2
20	0*	.00003	.0045	.0064	-2.2
21	0*	.00003	.0045	.0064	-2.2
22	0*	.00003	.0071	.0040	-2.4
23	0*	.00003	.0032	.0089	-2.0
24	0*	.00003	.0019	.0151	-1.8
25	0*	.00003	.0038	.0075	-2.1
26	0*	.00003	.0058	.0049	-2.3
27	0*	.00003	.0051	.0056	-2.3
28	0*	.00003	.0128	.0022	-2.7
29	0*	.00003	.0064	.0045	-2.3
30	0*	.00003	.0058	.0049	-2.3
31	0*	.00003	.0038	.0075	-2.1
32	0*	.00003	.0038	.0075	-2.1
33	0*	.00003	.0051	.0056	-2.3
34	0*	.00003	.0071	.0040	-2.4
35	0*	.00003	.0051	.0056	-2.3

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.23 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1996

Difference	N (n=34,953)	Probability the records match | difference (n=34,953)	Probability the records do not match | difference (n = 1,559)	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	34,278	.9807	.0064	152.8893	2.2
1	346	.0099	.0045	2.2047	0.3
2	55	.0016	.0058	.2726	-0.6
3	40	.0011	.0032	.3568	-0.4
4	22	.0006	.0013	.4906	-0.3
5	19	.0005	.0032	.1695	-0.8
6	16	.0005	.0064	.0714	-1.1
7	21	.0006	.0071	.0852	-1.1
8	8	.0002	.0058	.0396	-1.4
9	7	.0002	.0038	.0520	-1.3
10	30	.0009	.0077	.1115	-1.0
11	4	.0001	.0019	.0595	-1.2
12	3	.0001	.0051	.0167	-1.8
13	6	.0002	.0064	.0268	-1.6
14	9	.0003	.0083	.0309	-1.5
15	5	.0001	.0077	.0186	-1.7
16	4	.0001	.0032	.0357	-1.4
17	5	.0001	.0013	.1115	-1.0
18	5	.0001	.0045	.0319	-1.5
19	5	.0001	.0051	.0279	-1.6
20	7	.0002	.0071	.0284	-1.5
21	3	.0001	.0077	.0112	-2.0
22	2	.0001	.0045	.0127	-1.9
23	3	.0001	.0045	.0191	-1.7
24	7	.0002	.0038	.0520	-1.3
25	3	.0001	.0038	.0223	-1.7
26	3	.0001	.0045	.0191	-1.7
27	2	.0001	.0103	.0056	-2.3
28	4	.0001	.0058	.0198	-1.7
29	2	.0001	.0071	.0081	-2.1
30	2	.0001	.0051	.0112	-2.0
31	4	.0001	.0051	.0223	-1.7
32	1	.0000	.0064	.0045	-2.4
33	2	.0001	.0019	.0297	-1.5
34	0*	.0000	.0051	.0019	-2.7
35	3	.0001	.0051	.0167	-1.8

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.24 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1996

Variable	Number of errors in matched records	Prob. data agree in matched records	Number of errors in randomly linked records	Prob. data agree in randomly linked records	Ratio: match | agree not a match | agree	Log of Ratio: Marginal Contribution
Zip code	4,193 (n = 33, 497)	87.5	74 (n = 1,555)	4.8	18.23	+ 1.3
Sex	378 (n = 34,948)	98.9	783 (n = 1,559)	50.9	1.94	+ 0.3
Race	1,130 (n = 34,482)	96.7	285 (n = 1,538)	81.5	1.19	+ 0.1

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.25 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1996

Variable	Number of errors in matched records	Prob. data disagree in matched records	Number of errors in randomly linked records	Prob. data disagree in randomly linked Records	Ratio: disagree| match disagree| random	Log of Ratio: Marginal Contribution
Zip code	4,193 (n = 33, 497)	12.5	74 (n = 1,555)	95.2	0.13	- 0.9
Sex	378 (n = 34,948)	1.1	783 (n = 1,559)	49.1	0.02	- 1.7
Race	1130 (n = 34,482)	3.3	285 (n = 1,538)	18.5	0.18	- 0.8

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.26 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1996

Difference	N (n = 2,103)	Probability the records match | difference (n = 2,103)	Probability the records do not match | difference (n = 522)	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	2,035	.9677	.0690	14.0311	1.1
1	29	.0138	.0728	.1894	-0.7
2	10	.0048	.0785	.0605	-1.2
3	3	.0014	.0556	.0257	-1.6
4	6	.0029	.0460	.0621	-1.2
5	6	.0029	.0556	.0514	-1.3
6	3	.0014	.0651	.0219	-1.7
7	0*	.0005	.0441	.0113	-1.9
8	1	.0005	.0326	.0146	-1.8
9	0*	.0005	.0460	.0109	-2.0
10	4	.0019	.0383	.0496	-1.3
11	1	.0005	.0345	.0138	-1.9
12	0*	.0005	.0268	.0186	-1.7
13	0*	.0005	.0383	.0131	-1.9
14	1	.0005	.0345	.0138	-1.9
15	0*	.0005	.0345	.0145	-1.8
16	1	.0005	.0134	.0355	-1.5
17	0*	.0005	.0326	.0154	-1.8
18	0*	.0005	.0192	.0261	-1.6
19	1	.0005	.0096	.0496	-1.3
20	1	.0005	.0249	.0191	-1.7
21	0*	.0005	.0230	.0218	-1.7
22	0*	.0005	.0115	.0435	-1.4
23	0*	.0005	.0115	.0435	-1.4
24	0*	.0005	.0077	.0653	-1.2
25	0*	.0005	.0077	.0653	-1.2
26	1	.0005	.0115	.0414	-1.4
27	0*	.0005	.0019	.2610	-0.6
28	0*	.0005	.0096	.0522	-1.3
29	0*	.0005	.0057	.0870	-1.1
30	0*	.0005	.0019	.2610	-0.6
31	0*	.0005	.0020	.2500	-0.6
32	0*	.0005	.0057	.0870	-1.1
33	0*	.0005	.0019	.2610	-0.6
34	0*	.0005	.0019	.2610	-0.6
35	0*	.0005	.0019	.2610	-0.6

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.27 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1996

Difference	N (n = 2,103)	Probability the records match | difference (n = 2,103)	Probability the records do not match | difference (n = 545)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	2,068	.9834	.0220	44.6981	1.7
1	22	.0105	.0055	1.9005	0.3
2	2	.0010	.0018	.5283	-0.3
3	2	.0010	.0037	.2592	-0.6
4	2	.0010	.0018	.5183	-0.3
5	0*	.0005	.0018	.2725	-0.6
6	0*	.0005	.0073	.0681	-1.2
7	1	.0005	.0092	.0518	-1.3
8	2	.0010	.0018	.5283	-0.3
9	0*	.0005	.0018	.2725	-0.6
10	1	.0005	.0018	.2642	-0.6
11	2	.0010	.0055	.1728	-0.8
12	0*	.0005	.0037	.1362	-0.9
13	0*	.0005	.0055	.0908	-1.0
14	0*	.0005	.0018	.2778	-0.6
15	1	.0005	.0018	.2592	-0.6
16	0*	.0005	.0018	.2725	-0.6
17	0*	.0005	.0018	.2725	-0.6
18	0*	.0005	.0018	.2725	-0.6
19	0*	.0005	.0037	.1362	-0.9
20	0*	.0005	.0018	.2725	-0.6
21	0*	.0005	.0018	.2725	-0.6
22	0*	.0005	.0055	.0908	-1.0
23	0*	.0005	.0037	.1362	-0.9
24	0*	.0005	.0037	.1362	-0.9
25	0*	.0005	.0018	.2725	-0.6
26	0*	.0005	.0018	.2778	-0.6
27	0*	.0005	.0018	.2725	-0.6
28	0*	.0005	.0073	.0681	-1.2
29	0*	.0005	.0055	.0908	-1.0
30	0*	.0005	.0037	.1362	-0.9
31	0*	.0005	.0073	.0681	-1.2
32	0*	.0005	.0018	.2778	-0.6
33	0*	.0005	.0037	.1362	-0.9
34	0*	.0005	.0055	.0908	-1.0
35	0*	.0005	.0018	.2725	-0.6

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.28 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1996

Difference	N (n = 2,058)	Probability the records match | difference (n = 2,058)	Probability the records do not match | difference (n = 545)	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	1,928	.9368	.0092	102.1147	2.0
1	59	.0287	.0073	3.9061	0.6
2	9	.0044	.0018	2.3834	0.4
3	7	.0034	.0020	1.7007	0.2
4	9	.0044	.0020	2.1866	0.3
5	4	.0019	.0037	.5296	-0.3
6	0*	.0005	.0037	.1362	-0.9
7	5	.0024	.0055	.4414	-0.4
8	2	.0010	.0018	.5296	-0.3
9	2	.0010	.0018	.5296	-0.3
10	5	.0024	.0037	.6621	-0.2
11	1	.0005	.0037	.1324	-0.9
12	1	.0005	.0018	.2648	-0.6
13	0*	.0005	.0073	.0681	-1.2
14	2	.0010	.0020	.4859	-0.3
15	1	.0005	.0073	.0662	-1.2
16	0*	.0005	.0037	.1362	-0.9
17	1	.0005	.0018	.2648	-0.6
18	1	.0005	.0018	.2648	-0.6
19	0*	.0005	.0018	.2725	-0.6
20	1	.0005	.0037	.1324	-0.9
21	0*	.0005	.0018	.2725	-0.6
22	0*	.0005	.0020	.2500	-0.6
23	2	.0010	.0055	.1765	-0.8
24	1	.0005	.0018	.2648	-0.6
25	0*	.0005	.0018	.2725	-0.6
26	0*	.0005	.0037	.1362	-0.9
27	2	.0010	.0055	.1765	-0.8
28	3	.0015	.0073	.1986	-0.7
29	2	.0010	.0037	.2648	-0.6
30	0*	.0005	.0073	.0681	-1.2
31	1	.0005	.0055	.0883	-1.1
32	2	.0010	.0018	.5296	-0.3
33	0*	.0005	.0037	.1362	-0.9
34	0*	.0005	.0018	.2725	-0.6
35	0*	.0005	.0055	.0908	-1.0

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.29 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Skilled Nursing Facilities in 1996

Variable	Number of errors in matched records	Prob. data agree in matched records	Number of errors in randomly linked records	Prob. data agree in randomly linked records	Ratio: match | agree not a match | agree	Log of Ratio: Marginal Contribution
Zip code	259 (n = 2,033)	87.3	46 (n = 536)	8.6	10.2	+ 1.0
Sex	28 (n = 2,103)	98.7	264 (n = 543)	51.4	1.92	+ 0.3
Race	47 (n = 2,081)	97.7	446 (n = 535)	83.4	1.17	+ 0.1

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.30 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Skilled Nursing Facilities in 1996

Variable	Number of errors in matched records	Prob. data disagree in matched records	Number of errors in randomly linked records	Prob. data disagree in randomly linked Records	Ratio: disagree| match disagree| random	Log of Ratio: Marginal Contribution
Zip code	259 (n = 2,033)	12.7	46 (n = 536)	91.4	0.14	- 0.9
Sex	28 (n = 2,103)	1.3	264 (n = 543)	48.6	0.03	- 1.6
Race	47 (n = 2,081)	2.3	446 (n = 535)	16.6	0.14	- 0.9

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.31 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1997

Difference	N (n=31,004)	Probability the records match | difference (n=31,004)	Probability the records do not match | difference (n = 774)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	30,139	.9721	.0465	2.9002	1.3
1	415	.0134	.0736	.1818	-0.7
2	126	.0041	.0685	.0593	-1.2
3	76	.0025	.0801	.0306	-1.5
4	41	.0013	.0698	.0190	-1.7
5	29	.0009	.0568	.0165	-1.8
6	20	.0006	.0672	.0096	-2.0
7	17	.0005	.0530	.0104	-2.0
8	13	.0004	.0530	.0079	-2.1
9	19	.0006	.0530	.0116	-1.9
10	31	.0010	.0284	.0352	-1.5
11	6	.0002	.0413	.0047	-2.3
12	10	.0003	.0375	.0086	-2.1
13	10	.0003	.0439	.0073	-2.1
14	4	.0001	.0323	.0040	-2.4
15	8	.0003	.0220	.0117	-1.9
16	6	.0002	.0310	.0062	-2.2
17	2	.0001	.0220	.0029	-2.5
18	5	.0002	.0194	.0083	-2.1
19	2	.0001	.0090	.0071	-2.1
20	6	.0002	.0090	.0214	-1.7
21	3	.0001	.0155	.0062	-2.2
22	1	.0000	.0052	.0062	-2.2
23	2	.0001	.0078	.0083	-2.1
24	0*	.0000	.0039	.0083	-2.1
25	0*	.0000	.0039	.0083	-2.1
26	5	.0002	.0052	.0312	-1.5
27	1	.0000	.0039	.0083	-2.1
28	1	.0000	.0065	.0050	-2.3
29	0*	.0000	.0013	.0250	-1.6
30	3	.0001	.0026	.0374	-1.4
31	1	.0000	.0013	.0250	-1.6
32	0*	.0000	.0013	.0250	-1.6
33	0*	.0000	.0013	.0250	-1.6
34	1	.0000	.0013	.0250	-1.6
35	1	.0000	.0039	.0083	-2.1

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.32 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1997

Difference	N (n=31,005)	Probability the records match | difference (n=31,005)	Probability the records do not match | difference (n = 774)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	30,815	.9939	.0129	76.9257	1.9
1	117	.0038	.0052	.7302	-0.1
2	12	.0004	.0078	.0499	-1.3
3	9	.0003	.0142	.0204	-1.7
4	8	.0003	.0078	.0333	-1.5
5	4	.0001	.0065	.0200	-1.7
6	3	.0001	.0039	.0250	-1.6
7	2	.0001	.0052	.0125	-1.9
8	1	.0000	.0116	.0028	-2.6
9	7	.0002	.0039	.0582	-1.2
10	8	.0003	.0065	.0399	-1.4
11	0*	.0000	.0026	.0124	-1.9
12	1	.0000	.0026	.0125	-1.9
13	2	.0001	.0052	.0125	-1.9
14	0*	.0000	.0065	.0050	-2.3
15	1	.0000	.0026	.0125	-1.9
16	2	.0001	.0039	.0166	-1.8
17	2	.0001	.0103	.0062	-2.2
18	1	.0000	.0065	.0050	-2.3
19	1	.0000	.0026	.0125	-1.9
20	3	.0001	.0026	.0374	-1.4
21	0*	.0000	.0013	.0248	-1.6
22	0*	.0000	.0065	.0050	-2.3
23	0*	.0000	.0026	.0124	-1.9
24	1	.0000	.0065	.0050	-2.3
25	0*	.0000	.0078	.0041	-2.4
26	1	.0000	.0026	.0125	-1.9
27	2	.0001	.0052	.0125	-1.9
28	0*	.0000	.0142	.0023	-2.6
29	0*	.0000	.0090	.0035	-2.5
30	0*	.0000	.0052	.0062	-2.2
31	2	.0001	.0026	.0250	-1.6
32	0*	.0000	.0026	.0124	-1.9
33	0*	.0000	.0026	.0124	-1.9
34	0*	.0000	.0013	.0248	-1.6
35	0*	.0000	.0090	.0035	-2.5

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.33 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1997

Difference	N (n=31,005)	Probability the records match | difference (n=31,005)	Probability the records do not match | difference (n = 774)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	30,432	.9815	.0194	5.6464	1.7
1	282	.0091	.0039	2.3466	0.4
2	55	.0018	.0090	.1961	-0.7
3	39	.0013	.0039	.3245	-0.5
4	17	.0005	.0065	.0849	-1.1
5	23	.0007	.0065	.1148	-0.9
6	18	.0006	.0013	.4493	-0.3
7	13	.0004	.0078	.0541	-1.3
8	5	.0002	.0065	.0250	-1.6
9	7	.0002	.0052	.0437	-1.4
10	28	.0009	.0039	.2330	-0.6
11	5	.0002	.0026	.0624	-1.2
12	8	.0003	.0013	.1997	-0.7
13	6	.0002	.0181	.0107	-2.0
14	1	.0000	.0103	.0031	-2.5
15	3	.0001	.0065	.0150	-1.8
16	5	.0002	.0039	.0416	-1.4
17	6	.0002	.0039	.0499	-1.3
18	5	.0002	.0052	.0312	-1.5
19	5	.0002	.0052	.0312	-1.5
20	5	.0002	.0078	.0208	-1.7
21	4	.0001	.0039	.0333	-1.5
22	2	.0001	.0116	.0055	-2.3
23	2	.0001	.0039	.0166	-1.8
24	3	.0001	.0052	.0187	-1.7
25	1	.0000	.0026	.0125	-1.9
26	2	.0001	.0065	.0100	-2.0
27	1	.0000	.0090	.0036	-2.4
28	2	.0001	.0065	.0100	-2.0
29	2	.0001	.0078	.0083	-2.1
30	4	.0001	.0065	.0200	-1.7
31	6	.0002	.0116	.0166	-1.8
32	2	.0001	.0052	.0125	-1.9
33	1	.0000	.0103	.0031	-2.5
34	3	.0001	.0103	.0094	-2.0
35	2	.0001	.0052	.0125	-1.9

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.34 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1997

Variable	Number of errors in matched records	Prob. data agree in matched records	Number of errors in randomly linked records	Prob. data agree in randomly linked records	Ratio: match | agree not a match | agree	Log of Ratio: Marginal Contribution
Zip code	3,568 (n = 29,646)	88.0	23 (n = 373)	93.8	14.2	+ 1.2
Sex	328 (n = 31,005)	98.9	393 (n = 774)	50.8	1.95	+ 0.3
Race	983 (n = 30,541)	96.8	601 (n = 770)	78.1	1.24	+ 0.1

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.35 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Inpatient Rehabilitation Facilities in 1997

Variable	Number of errors in matched records	Prob. data disagree in matched records	Number of errors in randomly linked records	Prob. data disagree in randomly linked Records	Ratio: disagree| match disagree| random	Log of Ratio: Marginal Contribution
Zip code	3,568 (n = 29,646)	12.0	23 (n = 373)	93.8	0.13	- 0.9
Sex	328 (n = 31,005)	1.1	393 (n = 774)	49.1	0.02	- 1.6
Race	983 (n = 30,541)	3.2	601 (n = 770)	21.9	0.15	- 0.8

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.36 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Years for the Age Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1997

Difference	N (n = 2,610)	Probability the records match | difference (n = 2,610)	Probability the records do not match | difference (n = 859)	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	2,531	.9697	.0407	23.8000	1.4
1	36	.0138	.0536	.2576	-0.6
2	4	.0015	.0582	.0263	-1.6
3	9	.0034	.0582	.0592	-1.2
4	3	.0011	.0547	.0210	-1.7
5	4	.0015	.0477	.0321	-1.5
6	2	.0008	.0547	.0140	-1.9
7	2	.0008	.0664	.0115	-1.9
8	3	.0011	.0559	.0206	-1.7
9	3	.0011	.0407	.0282	-1.5
10	6	.0023	.0477	.0482	-1.3
11	2	.0008	.0338	.0227	-1.6
12	1	.0004	.0314	.0122	-1.9
13	0*	.0004	.0442	.0090	-2.0
14	0*	.0004	.0244	.0164	-1.8
15	0*	.0004	.0326	.0123	-1.9
16	1	.0004	.0221	.0173	-1.8
17	0*	.0004	.0279	.0143	-1.8
18	0*	.0004	.0233	.0172	-1.8
19	0*	.0004	.0186	.0215	-1.7
20	1	.0004	.0233	.0165	-1.8
21	0*	.0004	.0128	.0312	-1.5
22	1	.0004	.0151	.0253	-1.6
23	0*	.0004	.0198	.0202	-1.7
24	0*	.0004	.0128	.0312	-1.5
25	0*	.0004	.0058	.0687	-1.2
26	0*	.0004	.0058	.0687	-1.2
27	0*	.0004	.0070	.0573	-1.2
28	0*	.0004	.0093	.0430	-1.4
29	0*	.0004	.0058	.0687	-1.2
30	0*	.0004	.0047	.0859	-1.1
31	0*	.0004	.0047	.0859	-1.1
32	0*	.0004	.0070	.0573	-1.2
33	0*	.0004	.0010	.4000	-0.4
34	0*	.0004	.0023	.1718	-0.8
35	0*	.0004	.0047	.0859	-1.1

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.37 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Admission Date Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1997

Difference	N (n = 2,610)	Probability the records match | difference (n = 2,610)	Probability the records do not match | difference (n = 892)	Ratio of Pr(match|difference) Pr(not a match| difference)	Logarithm of Ratio
0	2,531	.9797	.0067	144.1668	2.2
1	68	.0261	.0056	4.6480	0.7
2	6	.0023	.0056	.4101	-0.4
3	1	.0004	.0078	.0488	-1.3
4	0*	.0004	.0090	.0446	-1.4
5	0*	.0004	.0034	.1189	-0.9
6	0*	.0004	.0056	.0714	-1.1
7	1	.0004	.0090	.0446	-1.4
8	0*	.0004	.0022	.1784	-0.7
9	0*	.0004	.0022	.1784	-0.7
10	0*	.0004	.0067	.0595	-1.2
11	0*	.0004	.0067	.0595	-1.2
12	1	.0004	.0056	.0714	-1.1
13	1	.0004	.0045	.0854	-1.1
14	0*	.0004	.0056	.0714	-1.1
15	0*	.0004	.0056	.0714	-1.1
16	0*	.0004	.0034	.1189	-0.9
17	0*	.0004	.0045	.0892	-1.0
18	1	.0004	.0078	.0510	-1.3
19	0*	.0004	.0067	.0595	-1.2
20	0*	.0004	.0011	.3568	-0.4
21	0*	.0004	.0090	.0446	-1.4
22	0*	.0004	.0045	.0892	-1.0
23	0*	.0004	.0056	.0714	-1.1
24	0*	.0004	.0022	.1784	-0.7
25	0*	.0004	.0045	.0892	-1.0
26	0*	.0004	.0045	.0892	-1.0
27	0*	.0004	.0056	.0714	-1.1
28	0*	.0004	.0067	.0595	-1.2
29	0*	.0004	.0078	.0510	-1.3
30	0*	.0004	.0045	.0892	-1.0
31	0*	.0004	.0078	.0510	-1.3
32	0*	.0004	.0034	.1189	-0.9
33	0*	.0004	.0045	.0892	-1.0
34	0*	.0004	.0067	.0595	-1.2
35	0*	.0004	.0045	.0892	-1.0

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.38 Probability that Records Match and Do Not Match and Marginal Contribution (Logarithm of Ratio) for Differences Between the Record Pairs of 0 to 35 Days for the Discharge Date Variable, Patients with Stroke Treated in Skilled Nursing Facilities in 1997

Difference	N (n = 2,520)	Probability the records match | difference (n = 2,520)	Probability the records do not match | difference (n = 892)	Ratio of Pr(match|difference) / Pr(not a match| difference)	Logarithm of Ratio
0	2,264	.8674	.0067	128.9584	2.1
1	109	.0418	.0056	7.4504	0.9
2	24	.0092	.0056	1.6405	0.2
3	15	.0057	.0078	.7323	-0.1
4	7	.0027	.0090	.2990	-0.5
5	8	.0031	.0034	.9114	0.0
6	5	.0019	.0056	.3418	-0.5
7	7	.0027	.0090	.2990	-0.5
8	5	.0019	.0022	.8544	-0.1
9	2	.0008	.0034	.2278	-0.6
10	6	.0023	.0067	.3418	-0.5
11	7	.0027	.0067	.3987	-0.4
12	1	.0004	.0056	.0684	-1.2
13	1	.0004	.0045	.0854	-1.1
14	2	.0008	.0056	.1367	-0.9
15	2	.0008	.0056	.1367	-0.9
16	2	.0008	.0034	.2278	-0.6
17	4	.0015	.0022	.6835	-0.2
18	3	.0011	.0078	.1465	-0.8
19	2	.0008	.0067	.1139	-0.9
20	1	.0004	.0011	.3418	-0.5
21	1	.0004	.0090	.0427	-1.4
22	4	.0015	.0045	.3418	-0.5
23	0*	.0004	.0056	.0714	-1.1
24	2	.0008	.0022	.3418	-0.5
25	1	.0004	.0045	.0854	-1.1
26	1	.0004	.0045	.0854	-1.1
27	1	.0004	.0056	.0684	-1.2
28	1	.0004	.0067	.0570	-1.2
29	1	.0004	.0078	.0488	-1.3
30	0*	.0004	.0045	.0892	-1.0
31	1	.0004	.0078	.0488	-1.3
32	0*	.0004	.0034	.1189	-0.9
33	1	.0004	.0045	.0854	-1.1
34	2	.0008	.0067	.1139	-0.9
35	1	.0004	.0045	.0854	-1.1

N refers to the number of cases; | , given; Pr, probability

* When no record pairs had a difference of this value, the probability of a match was estimated based on the disagreement of 1 record pair

Table D.39 Probability of Data Agreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Skilled Nursing Facilities in 1997

Variable	Number of errors in matched records	Prob. data agree in matched records	Number of errors in randomly linked records	Prob. data agree in randomly linked records	Ratio: match | agree not a match | agree	Log of Ratio: Marginal Contribution
Zip code	321 (n = 2,480)	87.1	68 (n = 403)	83.1	5.15	+ 0.7
Sex	37 (n = 2,610)	98.6	460 (n = 892)	51.6	1.91	+ 0.3
Race	59 (n = 2,588)	97.7	725 (n = 879)	82.5	1.18	+ 0.1

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Table D.40 Probability of Data Disagreement in Matched and Randomly Linked Record Pairs and Marginal Contribution for ZIP Code, Sex and Race Variables, Patients with Stroke Treated in Skilled Nursing Facilities in 1997

Variable	Number of errors in matched records	Prob. data disagree in matched records	Number of errors in randomly linked records	Prob. data disagree in randomly linked Records	Ratio: disagree| match disagree| random	Log of Ratio: Marginal Contribution
Zip code	321 (n = 2,480)	12.9	68 (n = 403)	16.9	0.16	- 0.8
Sex	37 (n = 2,610)	1.4	460 (n = 892)	48.4	0.03	- 1.5
Race	59 (n = 2,588)	2.3	725 (n = 879)	17.5	0.13	- 0.9

ZIP refers to Zone Improvement Planning; | , given; Prob., probability

Appendix E:
Procedures Used to Standardize Medicare Payment

Procedures Used to Standardize Medicare Payments

The Medicare payment data reported in the MedPAR file were already adjusted for factors such as regional wage index, indirect medical education (IME), disproportionate share of low-income patients (DSH), and location in a rural setting. The facilities included in this study represent a convenience sample; they were not randomly selected. The SNFs and IRFs included in the study differ in their geographic distribution, involvement with medical education, and their share of low-income patients.

In order to make a more fair comparison of Medicare payments across SNFs and IRFs, adjustments (increases or decreases) that were reflected in the reimbursement data were estimated and removed. This resulted in standardized payments that reflected: 1) a wage index of 1.000; 2) no indirect medical education adjustment, 3) no rural adjustment, 4) no adjustment for low-income patients.

For each patient record, the MedPAR file included a variable that reported the payment amount for indirect medical education and a separate variable that recorded the payment amount for disproportionate share. The wage adjustment and rural hospital adjustment data were not included in the data file, and had to be estimated.

The following procedures were applied to standardize (i.e., remove adjustments from) the MedPAR payment data:

1. Identified Medicare payment amount reported in MedPAR file.
2. Subtracted indirect medical education amount (recorded in the MedPAR file).
3. Subtracted disproportionate care amount (recorded in MedPAR file).
4. Adjusted labor-portion of payment data for wage index differences:
    a) The wage index percent difference was calculated by subtracting the wage index associated with the facility location as reported in the IRF-PPS Proposed Rule[122] from the standard of 1 (i.e., 1.000 - x.xxx). If the wage index was lower than 1 (i.e., 0.79), the difference was a positive value (e.g., 1.000 - 0.790 = .210). A wage index that was higher than 1.000 resulted in a negative value (e.g., 1.000 – 1.140 = -0.140).
    b) The labor portion of payments was estimated as 71 percent for IRFs and 75 percent for SNFs based on data reported in the PPS Proposed Rule[122] for IRFs and the Final Rule for SNFs.[30]
    c) The labor adjustment amount was calculated as the payment amount (already adjusted for IME and DSH in steps 2 and 3) multiplied by the labor percent (71% for IRFs and 75% for SNFs) and multiplied by the wage index difference.
    d) The payment amount (from step 3) and the labor adjustment value (calculated in 4c) were added together. Note that for facilities with a wage index < 1.000, the adjustment amount was a positive value, and for

facilities with a wage index > 1.000, the adjustment amount was a negative value.

5. For facilities located in rural locations, the payment amount was increased by a factor of 19.14%, the estimated adjustment used in the IRF proposed rule.[122]

For the analyses that combined 1996 and 1997 financial data, the 1996 data were increased by 1 percent to reflect the market basket rate of increase (i.e., inflation rate) for DRG-exempt hospitals and units as reported in the *Federal Register*'s Rules and Regulations: Changes to the Hospital Inpatient Prospective Payment Systems and Fiscal Year 1997 Rates.[123]

Appendix F:
Covariates

The Role of Covariates

The focus of this study was to assess the effect of rehabilitation setting (i.e., IRF versus SNF) on patient outcomes after adjusting for covariates. In the Results Chapter, the regression coefficients for the 14 covariates were reported, but were not discussed. To meet the regression model requirements, some of the data were transformed by using squared or cubed values, and the coefficients for these variables may be unstable.[112]

In this Appendix, the logistic and multiple linear regression analyses using the original (i.e., untransformed) data for each variable are reported and the role of the most important covariates is discussed. The discussion begins with a description of the role of covariates in predicting discharge to the community for patients with hip fracture, followed by a review of covariates that predicted discharge motor FIM ratings for patients with hip fracture.

The next section reports on the covariates associated with community discharge among patients with stroke, and the last section describes the role of covariates in predicting discharge motor FIM ratings for patients with stroke.

The Role of Covariates in Predicting Discharge to a Community-Based Setting, Patients with Hip Fracture, 1996 and 1997

The results of the logistic regression analyses predicting discharge to the community using untransformed covariate data for the 4 case-mix/age groups in 1996 and 1997 are presented in Tables F.1 to F.8.

Patients' admission FIM ratings were significantly associated with a community-based discharge for all 4 case-mix/age groups in 1996 and 1997. An increase of 1 motor FIM unit was associated with a 6 to 9 percent increased likelihood of a community discharge.

Admission cognitive FIM ratings were also associated with a community discharge for all 4 groups in 1996 and 1997. An increase of 1 cognitive FIM unit was associated with a 2 to 8 percent increased likelihood of a community discharge.

Patients who lived alone prior to the fracture were less likely to return to the community after rehabilitation. Odds ratios for the variable living alone were statistically significant for all 4 groups in 1996 and 1997, and estimates ranged from 0.47 to 0.64.

Patients with extracapsular fractures were less likely to return to the community. Estimated odds ratios ranged from 0.60 (Group 1 in 1996) to 0.83 (Group 3 in 1996).

Age was significantly associated with discharge destination for patients with mild to moderate disabilities (Group 1 and Group 2) in 1996, and all 4 groups in 1997. With each additional year, a return to the community was less likely, the odds ratios ranged from of 0.93 to 0.98 for the 2 groups in 1996 and the 4 groups in 1997.

Table F.1 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger (Group 1), 1996 Hip Fracture Database (n = 5,335)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time	-0.017	0.008	3.90	0.048	0.98	0.97	1.00
Admission motor FIM rating	0.088	0.011	59.53	0.000	1.09	1.07	1.12
Admission cognitive FIM rating	0.073	0.010	54.72	0.000	1.08	1.06	1.10
Type of hip fracture (Extracapsular fracture = 1)	-0.504	0.111	20.62	0.000	0.60	0.49	0.75
Tier 1 comorbidity (present =1)	0.631	1.045	0.37	0.546	1.88	0.24	14.56
Tier 2 comorbidity (present =1)	-0.182	0.300	0.37	0.543	0.83	0.46	1.50
Tier 3 comorbidity (present =1)	0.239	0.209	1.32	0.251	1.27	0.84	1.91
Age	-0.021	0.010	4.28	0.039	0.98	0.96	1.00
Pre-hospital living alone (alone =1)	-0.650	0.112	33.78	0.000	0.52	0.42	0.65
Median household income	0.000	0.000	0.63	0.426	1.00	1.00	1.00
Sex (female =1)	-0.182	0.147	1.52	0.218	0.83	0.62	1.11
Race (white =1)	0.110	0.255	0.18	0.668	1.12	0.68	1.84
Volume of patients	0.002	0.001	5.55	0.018	1.00	1.00	1.00
County managed care penetration	-0.155	0.341	0.21	0.649	0.86	0.44	1.67
Rehabilitation setting (IRF=1, SNF=0)	-0.004	0.177	0.00	0.983	1.00	0.70	1.41
Constant	-1.877	1.021	3.38	0.066	0.15	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table F.2 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older (Group 2), 1996 Hip Fracture Database (n = 3,287)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time	0.007	0.008	0.77	0.380	1.01	0.99	1.02
Admission motor FIM rating	0.064	0.011	34.96	0.000	1.07	1.04	1.09
Admission cognitive FIM rating	0.062	0.009	42.94	0.000	1.06	1.04	1.08
Type of hip fracture (Extracapsular fracture = 1)	-0.226	0.105	4.67	0.031	0.80	0.65	0.98
Tier 1 comorbidity (present =1)	-0.191	0.830	0.05	0.818	0.83	0.16	4.20
Tier 2 comorbidity (present =1)	-0.148	0.311	0.23	0.634	0.86	0.47	1.59
Tier 3 comorbidity (present =1)	0.080	0.248	0.10	0.748	1.08	0.67	1.76
Age	-0.068	0.014	22.90	0.000	0.93	0.91	0.96
Pre-hospital living alone (alone =1)	-0.474	0.109	18.74	0.000	0.62	0.50	0.77
Median household income	0.000	0.000	5.93	0.015	1.00	1.00	1.00
Sex (female =1)	-0.085	0.152	0.31	0.576	0.92	0.68	1.24
Race (white =1)	0.100	0.310	0.10	0.747	1.11	0.60	2.03
Volume of patients	0.001	0.001	3.16	0.076	1.00	1.00	1.00
County managed care penetration	0.780	0.324	5.81	0.016	2.18	1.16	4.11
Rehabilitation setting (IRF=1, SNF=0)	-0.324	0.167	3.76	0.052	0.72	0.52	1.00
Constant	3.285	1.424	5.32	0.021	26.70	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table F.3 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger (Group 3), 1996 Hip Fracture Database (n = 2,791)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time	0.010	0.007	1.97	0.161	1.01	1.00	1.02
Admission motor FIM rating	0.057	0.007	61.46	0.000	1.06	1.04	1.07
Admission cognitive FIM rating	0.026	0.006	15.95	0.000	1.03	1.01	1.04
Type of hip fracture (Extracapsular fracture = 1)	-0.183	0.095	3.71	0.054	0.83	0.69	1.00
Tier 1 comorbidity (present =1)	1.437	1.048	1.88	0.170	4.21	0.54	32.85
Tier 2 comorbidity (present =1)	-0.389	0.214	3.31	0.069	0.68	0.45	1.03
Tier 3 comorbidity (present =1)	-0.219	0.126	3.01	0.083	0.80	0.63	1.03
Age	-0.012	0.007	2.66	0.103	0.99	0.97	1.00
Pre-hospital living alone (alone =1)	-0.451	0.100	20.26	0.000	0.64	0.52	0.78
Median household income	0.000	0.000	1.86	0.173	1.00	1.00	1.00
Sex (female =1)	0.079	0.105	0.56	0.454	1.08	0.88	1.33
Race (white =1)	0.426	0.193	4.88	0.027	1.53	1.05	2.23
Volume of patients	0.001	0.001	4.90	0.027	1.00	1.00	1.00
County managed care penetration	-0.221	0.290	0.58	0.447	0.80	0.45	1.42
Rehabilitation setting (IRF=1, SNF=0)	-0.323	0.146	4.92	0.027	0.72	0.54	0.96
Constant	-0.064	0.641	0.01	0.921	0.94	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table F.4 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older (Group 4), 1996 Hip Fracture Database (n = 3,044)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time	0.003	0.007	0.15	0.697	1.00	0.99	1.02
Admission motor FIM rating	0.052	0.006	67.04	0.000	1.05	1.04	1.07
Admission cognitive FIM rating	0.027	0.006	23.59	0.000	1.03	1.02	1.04
Type of hip fracture (Extracapsular fracture = 1)	-0.313	0.080	15.36	0.000	0.73	0.62	0.85
Tier 1 comorbidity (present =1)	1.681	1.138	2.18	0.139	5.37	0.58	49.98
Tier 2 comorbidity (present =1)	-0.347	0.175	3.93	0.047	0.71	0.50	1.00
Tier 3 comorbidity (present =1)	-0.328	0.143	5.22	0.022	0.72	0.54	0.95
Age	-0.014	0.010	2.01	0.156	0.99	0.97	1.01
Pre-hospital living alone (alone =1)	-0.672	0.082	66.43	0.000	0.51	0.43	0.60
Median household income	0.000	0.000	2.63	0.105	1.00	1.00	1.00
Sex (female =1)	-0.042	0.104	0.16	0.686	0.96	0.78	1.18
Race (white =1)	0.089	0.164	0.30	0.587	1.09	0.79	1.51
Volume of patients	0.000	0.001	0.72	0.397	1.00	1.00	1.00
County managed care penetration	0.298	0.241	1.53	0.216	1.35	0.84	2.16
Rehabilitation setting (IRF=1, SNF=0)	-0.246	0.113	4.71	0.030	0.78	0.63	0.98
Constant	0.155	0.944	0.03	0.870	1.17	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table F.5 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger (Group 1), 1997 Hip Fracture Database (n = 5,277)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time	-0.016	0.008	3.69	0.055	0.98	0.97	1.00
Admission motor FIM rating	0.070	0.011	38.56	0.000	1.07	1.05	1.10
Admission cognitive FIM rating	0.077	0.010	61.30	0.000	1.08	1.06	1.10
Type of hip fracture (extracapsular fracture = 1)	-0.321	0.113	8.01	0.005	0.73	0.58	0.91
Tier 1 comorbidity (present =1)	-0.753	0.805	0.87	0.350	0.47	0.10	2.28
Tier 2 comorbidity (present =1)	-0.796	0.260	9.35	0.002	0.45	0.27	0.75
Tier 3 comorbidity (present =1)	-0.338	0.184	3.38	0.066	0.71	0.50	1.02
Age	-0.023	0.010	5.42	0.020	0.98	0.96	1.00
Pre-hospital living alone (alone =1)	-0.747	0.113	43.30	0.000	0.47	0.38	0.59
Median household income	0.000	0.000	0.00	0.996	1.00	1.00	1.00
Sex (female =1)	-0.058	0.139	0.17	0.679	0.94	0.72	1.24
Race (white =1)	-0.440	0.213	4.25	0.039	0.64	0.42	0.98
Volume of patients	0.000	0.001	0.24	0.626	1.00	1.00	1.00
County managed care penetration	0.211	0.359	0.35	0.557	1.23	0.61	2.50
Rehabilitation setting (IRF=1, SNF=0)	-0.126	0.159	0.62	0.430	0.88	0.65	1.21
Constant	-0.862	1.017	0.72	0.397	0.42	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table F.6 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older (Group 2), 1997 Hip Fracture Database (n = 3,452)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time	0.000	0.008	0.00	0.961	1.00	0.98	1.02
Admission motor FIM rating	0.065	0.010	38.71	0.000	1.07	1.05	1.09
Admission cognitive FIM rating	0.055	0.009	35.86	0.000	1.06	1.04	1.08
Type of hip fracture (Extracapsular fracture = 1)	-0.265	0.099	7.13	0.008	0.77	0.63	0.93
Tier 1 comorbidity (present =1)	3.405	5.272	0.42	0.518	30.12	0.00	926086
Tier 2 comorbidity (present =1)	-0.489	0.251	3.79	0.052	0.61	0.37	1.00
Tier 3 comorbidity (present =1)	-0.005	0.218	0.00	0.982	0.99	0.65	1.53
Age	-0.038	0.013	8.04	0.005	0.96	0.94	0.99
Pre-hospital living alone (alone =1)	-0.582	0.102	32.24	0.000	0.56	0.46	0.68
Median household income	0.000	0.000	0.00	0.995	1.00	1.00	1.00
Sex (female =1)	-0.175	0.146	1.44	0.230	0.84	0.63	1.12
Race (white =1)	0.423	0.280	2.29	0.130	1.53	0.88	2.64
Volume of patients	0.001	0.001	3.90	0.048	1.00	1.00	1.00
County managed care penetration	-0.059	0.307	0.04	0.847	0.94	0.52	1.72
Rehabilitation setting (IRF=1, SNF=0)	-0.236	0.125	3.59	0.058	0.79	0.62	1.01
Constant	0.734	1.330	0.30	0.581	2.08	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table F.7 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger (Group 3), 1997 Hip Fracture Database (n = 3,090)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	Upper Bound
Onset time	0.005	0.007	0.52	0.471	1.01	0.99	1.02
Admission motor FIM rating	0.051	0.007	56.09	0.000	1.05	1.04	1.07
Admission cognitive FIM rating	0.039	0.006	42.83	0.000	1.04	1.03	1.05
Type of hip fracture (Extracapsular fracture = 1)	-0.233	0.089	6.91	0.009	0.79	0.67	0.94
Tier 1 comorbidity (present =1)	0.328	0.610	0.29	0.591	1.39	0.42	4.59
Tier 2 comorbidity (present =1)	-0.072	0.178	0.16	0.687	0.93	0.66	1.32
Tier 3 comorbidity (present =1)	0.095	0.127	0.56	0.455	1.10	0.86	1.41
Age	-0.019	0.007	6.97	0.008	0.98	0.97	0.99
Pre-hospital living alone (alone =1)	-0.640	0.094	46.43	0.000	0.53	0.44	0.63
Median household income	0.000	0.000	0.00	0.964	1.00	1.00	1.00
Sex (female =1)	0.064	0.099	0.42	0.515	1.07	0.88	1.29
Race (white =1)	-0.058	0.156	0.14	0.711	0.94	0.70	1.28
Volume of patients	0.001	0.001	4.62	0.032	1.00	1.00	1.00
County managed care penetration	-0.114	0.270	0.18	0.673	0.89	0.53	1.52
Rehabilitation setting (IRF=1, SNF=0)	-0.164	0.118	1.93	0.165	0.85	0.67	1.07
Constant	0.076	0.628	0.01	0.904	1.08	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

Table F.8 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older (Group 4), 1997 Hip Fracture Database (n = 3,517)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β) Lower Bound	95% CI of Coefficient (β) Upper Bound
Onset time	0.007	0.006	1.29	0.256	1.01	0.99	1.02
Admission motor FIM rating	0.055	0.006	88.45	0.000	1.06	1.04	1.07
Admission cognitive FIM rating	0.025	0.005	22.14	0.000	1.02	1.01	1.04
Type of hip fracture (Extracapsular fracture = 1)	-0.261	0.075	12.29	0.000	0.77	0.67	0.89
Tier 1 comorbidity (present =1)	0.180	0.739	0.06	0.807	1.20	0.28	5.09
Tier 2 comorbidity (present =1)	-0.318	0.164	3.78	0.052	0.73	0.53	1.00
Tier 3 comorbidity (present =1)	-0.018	0.133	0.02	0.891	0.98	0.76	1.28
Age	-0.026	0.009	7.47	0.006	0.97	0.96	0.99
Pre-hospital living alone (alone =1)	-0.519	0.077	44.95	0.000	0.60	0.51	0.69
Median household income	0.000	0.000	0.03	0.859	1.00	1.00	1.00
Sex (female =1)	-0.137	0.094	2.12	0.145	0.87	0.72	1.05
Race (white =1)	0.476	0.156	9.23	0.002	1.61	1.18	2.19
Volume of patients	0.000	0.001	0.26	0.608	1.00	1.00	1.00
County managed care penetration	-0.300	0.229	1.72	0.190	0.74	0.47	1.16
Rehabilitation setting (IRF=1, SNF=0)	-0.397	0.094	17.69	0.000	0.67	0.56	0.81
Constant	1.144	0.878	1.70	0.193	3.14	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.
Transformations made to covariates are reported after the variable name in parentheses.

The Role of Covariates in Predicting Discharge Motor FIM Rating, Patients with Hip Fracture, 1996 and 1997

The results of the multiple linear regression analyses predicting discharge motor FIM ratings using untransformed covariate data for the 4 case-mix/age groups in 1996 and 1997 are presented in Tables F.9 to F.16.

Admission motor FIM ratings were significantly associated with the discharge motor FIM ratings across all 4 groups in 1996 and 1997. An increase of 1 FIM unit on admission was associated with an increase of 0.44 to 0.52 FIM units at the time of discharge for patients with mild to moderate disabilities (Group 1 and Group 2). For patients with severe disabilities (Group 3 and Group 4), an increase of 1 FIM unit on admission was associated with an increase of 1.02 to 1.08 FIM units at discharge.

Admission cognitive ratings were also significantly associated with discharge motor FIM ratings. An increase of 1 cognitive FIM unit was associated with an increase of 0.38 to 0.41 units for patients with mild to moderate disabilities (Group 1 and Group 2), and 0.46 to 0.51 for patients with severe disabilities (Group 3 and Group 4).

Patients who lived alone prior to the hip fracture tended to have higher discharge motor FIM ratings (i.e., more independence). The increase in the

discharge motor FIM ratings for patients who lived alone ranged from 1.02 to 3.18. Only patients with severe disabilities who were younger than 83 showed an effect that was greater than 2 FIM units.

Patients with extracapsular fractures may have had slightly lower discharge FIM ratings than patients with intracapsular fractures. Statistically significant effects were found for patients with mild to moderate disabilities (Group 1 and Group 2) in 1996, and all 4 groups in 1997. The difference in the discharge FIM ratings ranged from –0.64 to –1.32; all estimates were less than 2 FIM units.

Age was associated with lower discharge FIM ratings, but only for patients older than 82 years old (Group 2 and Group 4). With each additional year, discharge motor FIM ratings decreased by 0.21 to 0.35 units.

Having a ***tier 3 comorbidity*** was associated with a decrease in discharge motor FIM rating for patients with mild to moderate disabilities (Group 1 and Group 2) in 1997, and for young patients with severe disabilities (Group 3) in 1996 and 1997. The decrease in motor FIM rating was greater than 2 FIM units in Group 3 in 1996 only.

Table F.9 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger (Group 1), 1996 Hip Fracture Database (n = 5,335)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	39.44	1.59	--	24.82	0.000	36.32	42.55
Onset time	-0.10	0.02	-0.07	-5.87	0.000	-0.13	-0.06
Admission motor FIM rating	0.44	0.02	0.35	28.54	0.000	0.41	0.48
Admission cognitive FIM rating	0.40	0.02	0.24	19.12	0.000	0.36	0.44
Type of hip fracture (Extracapsular fracture = 1)	-0.85	0.20	-0.05	-4.35	0.000	-1.23	-0.47
Tier 1 comorbidity (present =1)	-2.63	1.55	-0.02	-1.70	0.089	-5.66	0.40
Tier 2 comorbidity (present =1)	-0.48	0.59	-0.01	-0.81	0.421	-1.64	0.69
Tier 3 comorbidity (present =1)	-0.37	0.34	-0.01	-1.10	0.271	-1.03	0.29
Age	-0.01	0.02	-0.01	-0.72	0.472	-0.04	0.02
Pre-hospital living alone (alone =1)	1.17	0.19	0.07	6.11	0.000	0.79	1.54
Median household income	0.00	0.00	0.02	1.92	0.055	0.00	0.00
Sex (female = 1)	-0.09	0.23	0.00	-0.38	0.707	-0.54	0.37
Race (white = 1)	0.58	0.42	0.02	1.39	0.166	-0.24	1.40
Volume of patients	0.00	0.00	0.02	1.80	0.073	0.00	0.00
County managed care penetration	-0.28	0.59	-0.01	-0.47	0.637	-1.44	0.88
Rehabilitation setting (IRF =1 , SNF = 0)	-0.79	0.30	-0.03	-2.61	0.009	-1.38	-0.20

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.10 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older (Group 2), 1996 Hip Fracture Database (n = 3,287)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	53.50	3.61	--	14.81	0.000	46.42	60.58
Onset time	-0.08	0.02	-0.06	-4.17	0.000	-0.12	-0.04
Admission motor FIM rating	0.51	0.02	0.35	22.15	0.000	0.46	0.55
Admission cognitive FIM rating	0.38	0.03	0.23	14.68	0.000	0.33	0.43
Type of hip fracture (Extracapsular fracture = 1)	-1.11	0.26	-0.07	-4.27	0.000	-1.62	-0.60
Tier 1 comorbidity (present =1)	0.38	2.40	0.00	0.16	0.873	-4.33	5.09
Tier 2 comorbidity (present =1)	0.18	0.83	0.00	0.22	0.827	-1.45	1.81
Tier 3 comorbidity (present =1)	-0.14	0.58	0.00	-0.24	0.807	-1.28	1.00
Age	-0.21	0.04	-0.09	-5.75	0.000	-0.28	-0.14
Pre-hospital living alone (alone =1)	1.34	0.26	0.08	5.15	0.000	0.83	1.85
Median household income	0.00	0.00	0.00	-0.04	0.965	0.00	0.00
Sex (female = 1)	-0.02	0.36	0.00	-0.06	0.950	-0.72	0.68
Race (white = 1)	0.58	0.70	0.01	0.83	0.406	-0.79	1.96
Volume of patients	0.00	0.00	0.01	0.63	0.530	0.00	0.00
County managed care penetration	0.85	0.78	0.02	1.08	0.278	-0.69	2.39
Rehabilitation setting (IRF =1 , SNF = 0)	-1.40	0.38	-0.06	-3.71	0.000	-2.15	-0.66

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.11 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger (Group 3), 1996 Hip Fracture Database (n = 2,791)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	9.21	2.91	--	3.16	0.002	3.50	14.92
Onset time	-0.14	0.03	-0.06	-4.17	0.000	-0.20	-0.07
Admission motor FIM rating	1.08	0.04	0.49	30.76	0.000	1.01	1.15
Admission cognitive FIM rating	0.46	0.03	0.24	15.19	0.000	0.40	0.52
Type of hip fracture (Extracapsular fracture = 1)	-0.30	0.44	-0.01	-0.69	0.489	-1.16	0.56
Tier 1 comorbidity (present =1)	-0.62	2.72	0.00	-0.23	0.821	-5.95	4.72
Tier 2 comorbidity (present =1)	-1.15	1.06	-0.02	-1.09	0.275	-3.22	0.92
Tier 3 comorbidity (present =1)	-2.69	0.60	-0.06	-4.51	0.000	-3.86	-1.52
Age	-0.01	0.03	0.00	-0.31	0.757	-0.08	0.05
Pre-hospital living alone (alone =1)	3.18	0.47	0.10	6.79	0.000	2.26	4.09
Median household income	0.00	0.00	0.02	1.28	0.201	0.00	0.00
Sex (female = 1)	0.25	0.48	0.01	0.52	0.606	-0.70	1.19
Race (white = 1)	-1.00	0.79	-0.02	-1.26	0.208	-2.56	0.56
Volume of patients	0.00	0.00	0.02	1.64	0.100	0.00	0.01
County managed care penetration	-0.70	1.33	-0.01	-0.52	0.600	-3.32	1.92
Rehabilitation setting (IRF =1 , SNF = 0)	-0.08	0.65	0.00	-0.12	0.902	-1.35	1.19

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.12 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older (Group 4), 1996 Hip Fracture Database (n = 3,044)

Variable	Unstandardized Coefficients		Stand-ardized	t	P	95% CI of Coefficient (β)	
	β	Std. Error	β			Lower Bound	Upper Bound
Intercept	37.80	4.59	--	8.23	0.000	28.79	46.80
Onset time	-0.12	0.03	-0.05	-3.75	0.000	-0.18	-0.06
Admission motor FIM rating	1.07	0.03	0.51	34.55	0.000	1.00	1.13
Admission cognitive FIM rating	0.47	0.03	0.25	17.06	0.000	0.42	0.52
Type of hip fracture (Extracapsular fracture = 1)	-0.59	0.39	-0.02	-1.50	0.132	-1.35	0.18
Tier 1 comorbidity (present =1)	1.08	4.31	0.00	0.25	0.803	-7.38	9.53
Tier 2 comorbidity (present =1)	-0.98	0.87	-0.01	-1.12	0.264	-2.69	0.74
Tier 3 comorbidity (present =1)	-1.17	0.71	-0.02	-1.64	0.102	-2.57	0.23
Age	-0.35	0.05	-0.09	-7.17	0.000	-0.45	-0.25
Pre-hospital living alone (alone =1)	1.68	0.40	0.06	4.23	0.000	0.90	2.46
Median household income	0.00	0.00	0.04	2.82	0.005	0.00	0.00
Sex (female = 1)	0.24	0.50	0.01	0.48	0.635	-0.74	1.21
Race (white = 1)	-0.43	0.78	-0.01	-0.55	0.584	-1.96	1.11
Volume of patients	0.01	0.00	0.03	2.13	0.033	0.00	0.01
County managed care penetration	-1.64	1.17	-0.02	-1.40	0.160	-3.93	0.65
Rehabilitation setting (IRF =1 , SNF = 0)	-0.74	0.54	-0.02	-1.38	0.168	-1.79	0.31

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.13 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 82 Years of Age or Younger (Group 1), 1997 Hip Fracture Database (n = 5,277)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	38.99	1.60	--	24.33	0.000	35.85	42.13
Onset time	-0.10	0.02	-0.07	-5.93	0.000	-0.13	-0.07
Admission motor FIM rating	0.44	0.02	0.34	27.32	0.000	0.41	0.48
Admission cognitive FIM rating	0.38	0.02	0.23	18.17	0.000	0.34	0.43
Type of hip fracture (Extracapsular fracture = 1)	-0.62	0.20	-0.04	-3.10	0.002	-1.02	-0.23
Tier 1 comorbidity (present =1)	-2.67	1.97	-0.02	-1.36	0.175	-6.53	1.19
Tier 2 comorbidity (present =1)	-0.71	0.60	-0.01	-1.17	0.243	-1.89	0.48
Tier 3 comorbidity (present =1)	-1.66	0.35	-0.06	-4.73	0.000	-2.35	-0.97
Age	-0.01	0.02	-0.01	-0.88	0.377	-0.04	0.02
Pre-hospital living alone (alone =1)	1.35	0.20	0.09	6.91	0.000	0.97	1.73
Median household income	0.00	0.00	0.02	1.44	0.149	0.00	0.00
Sex (female = 1)	0.06	0.23	0.00	0.27	0.783	-0.39	0.52
Race (white = 1)	-0.54	0.42	-0.02	-1.30	0.194	-1.36	0.28
Volume of patients	0.00	0.00	0.03	2.31	0.021	0.00	0.01
County managed care penetration	0.96	0.62	0.02	1.56	0.118	-0.25	2.17
Rehabilitation setting (IRF =1 , SNF = 0)	0.04	0.26	0.00	0.14	0.890	-0.47	0.54

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.14 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 701, 702 and 703) and 83 Years of Age or Older (Group 2), 1997 Hip Fracture Database (n = 3,452)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	54.67	3.59	--	15.22	0.000	47.63	61.71
Onset time	-0.07	0.02	-0.05	-3.38	0.001	-0.11	-0.03
Admission motor FIM rating	0.52	0.02	0.34	21.92	0.000	0.47	0.56
Admission cognitive FIM rating	0.41	0.03	0.23	15.33	0.000	0.36	0.46
Type of hip fracture (Extracapsular fracture = 1)	-0.94	0.27	-0.05	-3.50	0.000	-1.47	-0.41
Tier 1 comorbidity (present =1)	-1.20	3.05	-0.01	-0.39	0.694	-7.19	4.78
Tier 2 comorbidity (present =1)	-0.65	0.77	-0.01	-0.85	0.397	-2.15	0.85
Tier 3 comorbidity (present =1)	-1.24	0.58	-0.03	-2.14	0.033	-2.38	-0.10
Age	-0.26	0.04	-0.11	-7.09	0.000	-0.33	-0.19
Pre-hospital living alone (alone =1)	1.02	0.26	0.06	3.87	0.000	0.50	1.53
Median household income	0.00	0.00	0.04	2.24	0.025	0.00	0.00
Sex (female = 1)	-0.26	0.36	-0.01	-0.74	0.461	-0.96	0.44
Race (white = 1)	-1.08	0.67	-0.02	-1.63	0.104	-2.39	0.22
Volume of patients	0.00	0.00	0.02	1.08	0.282	0.00	0.01
County managed care penetration	0.65	0.82	0.01	0.79	0.428	-0.96	2.25
Rehabilitation setting (IRF =1 , SNF = 0)	-0.25	0.32	-0.01	-0.80	0.426	-0.87	0.37

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.15 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 82 Years of Age or Younger (Group 3), 1997 Hip Fracture Database (n = 3,090)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	11.21	2.81	--	3.99	0.000	5.70	16.72
Onset time	-0.12	0.03	-0.05	-3.69	0.000	-0.18	-0.06
Admission motor FIM rating	1.02	0.03	0.48	31.14	0.000	0.96	1.08
Admission cognitive FIM rating	0.49	0.03	0.26	17.00	0.000	0.43	0.55
Type of hip fracture (Extracapsular fracture = 1)	-0.84	0.41	-0.03	-2.03	0.043	-1.65	-0.03
Tier 1 comorbidity (present =1)	-0.80	2.62	0.00	-0.30	0.761	-5.95	4.35
Tier 2 comorbidity (present =1)	-1.36	0.87	-0.02	-1.57	0.116	-3.06	0.34
Tier 3 comorbidity (present =1)	-1.55	0.58	-0.04	-2.66	0.008	-2.68	-0.41
Age	-0.03	0.03	-0.01	-0.83	0.409	-0.09	0.04
Pre-hospital living alone (alone =1)	2.22	0.44	0.07	5.02	0.000	1.35	3.08
Median household income	0.00	0.00	0.03	2.39	0.017	0.00	0.00
Sex (female = 1)	-0.01	0.46	0.00	-0.02	0.982	-0.90	0.88
Race (white = 1)	-1.26	0.72	-0.02	-1.74	0.083	-2.67	0.16
Volume of patients	0.01	0.00	0.03	2.37	0.018	0.00	0.01
County managed care penetration	-1.55	1.26	-0.02	-1.24	0.217	-4.02	0.91
Rehabilitation setting (IRF =1 , SNF = 0)	0.42	0.54	0.01	0.77	0.440	-0.64	1.48

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.16 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 704 and 705) and 83 Years of Age or Older (Group 4), 1997 Hip Fracture Database (n = 3,517)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	35.79	4.43	--	8.08	0.000	27.11	44.48
Onset time	-0.08	0.03	-0.03	-2.71	0.007	-0.14	-0.02
Admission motor FIM rating	1.03	0.03	0.49	35.41	0.000	0.97	1.09
Admission cognitive FIM rating	0.51	0.03	0.27	19.27	0.000	0.46	0.56
Type of hip fracture (Extracapsular fracture = 1)	-1.32	0.37	-0.04	-3.54	0.000	-2.06	-0.59
Tier 1 comorbidity (present =1)	-1.25	3.62	0.00	-0.34	0.730	-8.34	5.84
Tier 2 comorbidity (present =1)	-1.31	0.84	-0.02	-1.56	0.119	-2.97	0.34
Tier 3 comorbidity (present =1)	-1.03	0.66	-0.02	-1.55	0.122	-2.33	0.27
Age	-0.31	0.05	-0.08	-6.55	0.000	-0.40	-0.22
Pre-hospital living alone (alone =1)	1.79	0.38	0.06	4.67	0.000	1.04	2.55
Median household income	0.00	0.00	0.04	3.17	0.002	0.00	0.00
Sex (female = 1)	-0.64	0.46	-0.02	-1.37	0.170	-1.54	0.27
Race (white = 1)	-0.63	0.74	-0.01	-0.85	0.394	-2.09	0.82
Volume of patients	0.00	0.00	0.02	1.22	0.222	0.00	0.01
County managed care penetration	-1.77	1.14	-0.02	-1.54	0.122	-4.01	0.48
Rehabilitation setting (IRF =1 , SNF = 0)	-1.29	0.46	-0.04	-2.80	0.005	-2.19	-0.38

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

The Role of Covariates in Predicting Discharge to a Community-Based Setting, Patients with Stroke, 1996 and 1997

The results of the logistic regression analyses predicting discharge to a community-based setting using untransformed covariate data for the 4 case-mix/age groups in 1996 and 1997 for patients with stroke are presented in Tables F.17 to F.24.

Admission FIM ratings were significantly associated with a community-based discharge for all 4 groups in 1996 and 1997. An increase of 1 motor FIM unit was associated with a 6 to 8 percent increased likelihood of a community discharge.

Admission cognitive FIM ratings were also associated with community discharge for all 4 groups in 1996 and 1997. An increase of 1 cognitive FIM unit was associated with a 7 to 8 percent increased likelihood of a community discharge for patients with mild to moderate disability (Group 1 and Group 2), and 2 to 3 percent for patients with severe disability (Group 3 and Group 4).

Age was significantly associated with discharge destination for patients in all 4 groups in 1996 and 1997. An increase of 1 year was associated with odds ratios that ranged from 0.95 (Group 2 in 1996) to 0.98 (Group 3 and Group 4 in 1996 and Group 1 and Group 4 in 1997).

Patients who lived alone prior to the stroke were less likely to return to the community after rehabilitation for patients in all 4 groups in 1996 and 1997. Odds ratios for the variable living alone were statistically significant for all 4 groups in 1996 and 1997, and estimates ranged from 0.26 (Group 1 in 1996) to 0.54 (Group 2 in 1997).

Patients who were white were more likely to return to the community following a rehabilitation stay. Significant effects were found for patients in all 4 groups in 1996 and 1997. Effects were stronger for older patients compared to younger patients, and stronger for patients with severe disabilities compared to patients with mild to moderate disabilities. Effects ranged from a 30 percent increase for young patients with mild to moderate disabilities (Group 1) to a 130 percent increase for older patients with severe disability (Group 4).

Among the patients with mild to moderate disabilities who were older than 77 (Group 2), those who experienced a ***hemorrhagic stroke*** were less likely to return to the community. Odds ratios were 0.78 in 1996 and 0.74 in 1997. No effect was found for patients in other groups.

The presence of a ***tier 3 comorbidity*** decreased the likelihood of a community discharge for Group 1, Group 3 and Group 4 in 1996, and Group 1 and Group 2 in 1997. Odds ratios ranged from 0.72 (Group 1 and Group 2 in 1997) to 0.81 (Group 3 and Group 4 in 1996).

Table F.17 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger (Group 1), 1996 Stroke Database (n = 9,346)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time	0.011	0.006	3.23	0.072	1.01	1.00	1.02
Admission motor FIM rating	0.074	0.006	133.8	0.000	1.08	1.06	1.09
Admission cognitive FIM rating	0.078	0.006	179.0	0.000	1.08	1.07	1.09
Type of stroke (hemorrhage = 1)	-0.245	0.134	3.37	0.066	0.78	0.60	1.02
Tier 1 comorbidity (present =1)	0.491	1.034	0.23	0.635	1.63	0.22	12.39
Tier 2 comorbidity (present =1)	-0.323	0.321	1.02	0.314	0.72	0.39	1.36
Tier 3 comorbidity (present =1)	-0.290	0.142	4.20	0.040	0.75	0.57	0.99
Age	-0.038	0.009	18.69	0.000	0.96	0.95	0.98
Pre-hospital living alone (alone =1)	-1.344	0.091	218.0	0.000	0.26	0.22	0.31
Median household income	0.000	0.000	0.29	0.588	1.00	1.00	1.00
Sex (female =1)	0.001	0.090	0.00	0.993	1.00	0.84	1.19
Race (white =1)	0.265	0.127	4.38	0.036	1.30	1.02	1.67
Volume of patients	0.000	0.000	0.81	0.369	1.00	1.00	1.00
County managed care penetration	-0.440	0.274	2.58	0.109	0.64	0.38	1.10
Rehabilitation setting (IRF=1, SNF=0)	0.741	0.202	13.51	0.000	2.10	1.41	3.11
Constant	-0.466	0.753	0.38	0.536	0.63	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.18 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older (Group 2), 1996 Stroke Database (n = 7,175)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time	0.002	0.005	0.12	0.724	1.00	0.99	1.01
Admission motor FIM rating	0.072	0.006	170.9	0.000	1.08	1.06	1.09
Admission cognitive FIM rating	0.064	0.005	161.0	0.000	1.07	1.06	1.08
Type of stroke (hemorrhage = 1)	-0.246	0.120	4.21	0.040	0.78	0.62	0.99
Tier 1 comorbidity (present =1)	-0.920	0.710	1.68	0.195	0.40	0.10	1.60
Tier 2 comorbidity (present =1)	0.165	0.352	0.22	0.640	1.18	0.59	2.35
Tier 3 comorbidity (present =1)	0.150	0.161	0.87	0.351	1.16	0.85	1.59
Age	-0.050	0.008	34.21	0.000	0.95	0.94	0.97
Pre-hospital living alone (alone =1)	-0.853	0.077	122.44	0.000	0.43	0.37	0.50
Median household income	0.000	0.000	0.61	0.435	1.00	1.00	1.00
Sex (female =1)	-0.113	0.080	2.01	0.157	0.89	0.76	1.04
Race (white =1)	0.468	0.150	9.70	0.002	1.60	1.19	2.14
Volume of patients	0.001	0.000	2.21	0.137	1.00	1.00	1.00
County managed care penetration	0.370	0.235	2.48	0.115	1.45	0.91	2.29
Rehabilitation setting (IRF=1, SNF=0)	0.268	0.155	2.99	0.084	1.31	0.96	1.77
Constant	0.888	0.811	1.20	0.274	2.43	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.19 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger (Group 3), 1996 Stroke Database (n = 7,466)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time	0.000	0.003	0.00	0.959	1.00	0.99	1.01
Admission motor FIM rating	0.076	0.004	389.9	0.000	1.08	1.07	1.09
Admission cognitive FIM rating	0.025	0.004	47.25	0.000	1.03	1.02	1.03
Type of stroke (hemorrhage = 1)	0.093	0.082	1.30	0.254	1.10	0.94	1.29
Tier 1 comorbidity (present =1)	-0.099	0.272	0.13	0.717	0.91	0.53	1.54
Tier 2 comorbidity (present =1)	-0.267	0.165	2.61	0.106	0.77	0.55	1.06
Tier 3 comorbidity (present =1)	-0.214	0.083	6.73	0.009	0.81	0.69	0.95
Age	-0.018	0.005	15.30	0.000	0.98	0.97	0.99
Pre-hospital living alone (alone =1)	-0.954	0.062	233.9	0.000	0.39	0.34	0.44
Median household income	0.000	0.000	5.50	0.019	1.00	1.00	1.00
Sex (female =1)	0.002	0.055	0.00	0.965	1.00	0.90	1.12
Race (white =1)	0.307	0.070	19.20	0.000	1.36	1.18	1.56
Volume of patients	0.000	0.000	1.41	0.235	1.00	1.00	1.00
County managed care penetration	-0.274	0.170	2.60	0.107	0.76	0.55	1.06
Rehabilitation setting (IRF=1, SNF=0)	0.461	0.130	12.64	0.000	1.59	1.23	2.05
Constant	-0.469	0.373	1.58	0.209	0.63	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.20 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older (Group 4), 1996 Stroke Database (n = 6,358)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time	0.006	0.003	3.15	0.076	1.01	1.00	1.01
Admission motor FIM rating	0.065	0.004	291.5	0.000	1.07	1.06	1.08
Admission cognitive FIM rating	0.023	0.004	36.35	0.000	1.02	1.02	1.03
Type of stroke (hemorrhage = 1)	-0.162	0.092	3.11	0.078	0.85	0.71	1.02
Tier 1 comorbidity (present =1)	-0.061	0.371	0.03	0.869	0.94	0.46	1.95
Tier 2 comorbidity (present =1)	-0.327	0.198	2.74	0.098	0.72	0.49	1.06
Tier 3 comorbidity (present =1)	-0.212	0.097	4.79	0.029	0.81	0.67	0.98
Age	-0.019	0.006	8.38	0.004	0.98	0.97	0.99
Pre-hospital living alone (alone =1)	-0.792	0.059	177.8	0.000	0.45	0.40	0.51
Median household income	0.000	0.000	7.69	0.006	1.00	1.00	1.00
Sex (female =1)	0.012	0.058	0.05	0.831	1.01	0.90	1.13
Race (white =1)	0.852	0.089	91.80	0.000	2.34	1.97	2.79
Volume of patients	0.000	0.000	0.03	0.863	1.00	1.00	1.00
County managed care penetration	0.130	0.171	0.58	0.447	1.14	0.81	1.59
Rehabilitation setting (IRF=1, SNF=0)	0.134	0.115	1.35	0.245	1.14	0.91	1.43
Constant	-0.277	0.564	0.24	0.623	0.76	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.21 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger (Group 1), 1997 Stroke Database (n = 8,552)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time	-0.014	0.005	7.41	0.006	0.99	0.98	1.00
Admission motor FIM rating	0.055	0.006	76.05	0.000	1.06	1.04	1.07
Admission cognitive FIM rating	0.066	0.006	123.0	0.000	1.07	1.06	1.08
Type of stroke (hemorrhage = 1)	0.063	0.146	0.19	0.665	1.07	0.80	1.42
Tier 1 comorbidity (present =1)	3.510	3.648	0.93	0.336	33.45	0.03	42614
Tier 2 comorbidity (present =1)	-0.442	0.300	2.17	0.141	0.64	0.36	1.16
Tier 3 comorbidity (present =1)	-0.328	0.144	5.19	0.023	0.72	0.54	0.96
Age	-0.018	0.008	5.28	0.022	0.98	0.97	1.00
Pre-hospital living alone (alone =1)	-0.780	0.094	69.50	0.000	0.46	0.38	0.55
Median household income	0.000	0.000	1.53	0.216	1.00	1.00	1.00
Sex (female =1)	-0.069	0.093	0.56	0.454	0.93	0.78	1.12
Race (white =1)	0.343	0.129	7.02	0.008	1.41	1.09	1.82
Volume of patients	0.001	0.000	9.50	0.002	1.00	1.00	1.00
County managed care penetration	0.033	0.293	0.01	0.909	1.03	0.58	1.84
Rehabilitation setting (IRF=1, SNF=0)	0.157	0.214	0.54	0.463	1.17	0.77	1.78
Constant	-0.402	0.711	0.32	0.572	0.67	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.22 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older (Group 2), 1997 Stroke Database (n = 6,930)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time	-0.001	0.005	0.02	0.898	1.00	0.99	1.01
Admission motor FIM rating	0.062	0.006	109.8	0.000	1.06	1.05	1.08
Admission cognitive FIM rating	0.067	0.005	152.2	0.000	1.07	1.06	1.08
Type of stroke (hemorrhage = 1)	-0.298	0.131	5.19	0.023	0.74	0.57	0.96
Tier 1 comorbidity (present =1)	0.411	0.760	0.29	0.588	1.51	0.34	6.70
Tier 2 comorbidity (present =1)	-0.347	0.342	1.03	0.311	0.71	0.36	1.38
Tier 3 comorbidity (present =1)	-0.331	0.149	4.93	0.026	0.72	0.54	0.96
Age	-0.038	0.009	17.04	0.000	0.96	0.95	0.98
Pre-hospital living alone (alone =1)	-0.624	0.083	57.02	0.000	0.54	0.46	0.63
Median household income	0.000	0.000	26.48	0.000	1.00	1.00	1.00
Sex (female =1)	-0.218	0.087	6.25	0.012	0.80	0.68	0.95
Race (white =1)	0.501	0.159	9.89	0.002	1.65	1.21	2.26
Volume of patients	0.000	0.000	0.01	0.911	1.00	1.00	1.00
County managed care penetration	0.615	0.257	5.72	0.017	1.85	1.12	3.06
Rehabilitation setting (IRF=1, SNF=0)	0.436	0.145	9.08	0.003	1.55	1.16	2.05
Constant	0.796	0.867	0.84	0.359	2.22	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.23 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger (Group 3), 1997 Stroke Database (n = 6,623)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time	0.006	0.003	3.37	0.066	1.01	1.00	1.01
Admission motor FIM rating	0.077	0.004	339.1	0.000	1.08	1.07	1.09
Admission cognitive FIM rating	0.025	0.004	38.77	0.000	1.03	1.02	1.03
Type of stroke (hemorrhage = 1)	-0.064	0.085	0.58	0.446	0.94	0.79	1.11
Tier 1 comorbidity (present =1)	0.372	0.388	0.92	0.338	1.45	0.68	3.10
Tier 2 comorbidity (present =1)	-0.013	0.172	0.01	0.938	0.99	0.70	1.38
Tier 3 comorbidity (present =1)	-0.129	0.089	2.12	0.145	0.88	0.74	1.05
Age	-0.025	0.005	24.63	0.000	0.97	0.97	0.98
Pre-hospital living alone (alone =1)	-0.934	0.067	192.6	0.000	0.39	0.34	0.45
Median household income	0.000	0.000	5.64	0.018	1.00	1.00	1.00
Sex (female =1)	-0.107	0.060	3.17	0.075	0.90	0.80	1.01
Race (white =1)	0.453	0.077	34.60	0.000	1.57	1.35	1.83
Volume of patients	0.000	0.000	2.25	0.133	1.00	1.00	1.00
County managed care penetration	-0.600	0.187	10.33	0.001	0.55	0.38	0.79
Rehabilitation setting (IRF=1, SNF=0)	0.254	0.131	3.76	0.053	1.29	1.00	1.67
Constant	0.207	0.415	0.25	0.618	1.23	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.24 Logistic Regression Analysis of Community-Based Discharge for Covariates and Rehabilitation Setting, Patients with Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older (Group 4), 1997 Stroke Database (n = 6,274)

Variable	β	Std. Error	Wald	P	Odds Ratio	95% CI of Coefficient (β)	
						Lower Bound	Upper Bound
Onset time	0.009	0.003	6.00	0.014	1.01	1.00	1.02
Admission motor FIM rating	0.076	0.004	355.9	0.000	1.08	1.07	1.09
Admission cognitive FIM rating	0.021	0.004	29.38	0.000	1.02	1.01	1.03
Type of stroke (hemorrhage = 1)	0.096	0.093	1.05	0.305	1.10	0.92	1.32
Tier 1 comorbidity (present =1)	-0.110	0.374	0.09	0.769	0.90	0.43	1.87
Tier 2 comorbidity (present =1)	-0.003	0.191	0.00	0.988	1.00	0.69	1.45
Tier 3 comorbidity (present =1)	-0.123	0.098	1.59	0.208	0.88	0.73	1.07
Age	-0.023	0.007	11.67	0.001	0.98	0.96	0.99
Pre-hospital living alone (alone =1)	-0.780	0.062	157.8	0.000	0.46	0.41	0.52
Median household income	0.000	0.000	14.09	0.000	1.00	1.00	1.00
Sex (female =1)	-0.014	0.060	0.06	0.811	0.99	0.88	1.11
Race (white =1)	0.691	0.091	58.12	0.000	2.00	1.67	2.38
Volume of patients	0.000	0.000	0.05	0.821	1.00	1.00	1.00
County managed care penetration	-0.013	0.179	0.00	0.944	0.99	0.70	1.40
Rehabilitation setting (IRF=1, SNF=0)	-0.106	0.110	0.92	0.336	0.90	0.72	1.12
Constant	0.106	0.585	0.03	0.856	1.11	--	--

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

The Role of Covariates in Predicting Discharge Motor FIM Ratings, Patients with Stroke, 1996 and 1997

The results of the multiple linear regression analyses predicting discharge motor FIM ratings using untransformed covariate data for the 4 case-mix/age groups in 1996 and 1997 are presented in Tables F.25 to F.32.

Admission motor FIM ratings were significantly associated with the discharge motor FIM ratings across all 4 groups in 1996 and 1997. An increase of 1 FIM unit on admission was associated with an increase of 0.58 to 0.63 FIM units at the time of discharge for patients with mild to moderate disabilities (Group 1 and Group 2). For patients with severe disabilities (Group 3 and Group 4), an increase of 1 FIM unit on admission was associated with an increase of 1.22 to 1.30 FIM units at discharge.

Admission cognitive ratings were also significantly associated with discharge motor FIM ratings. An increase of 1 cognitive FIM unit was associated with an increase of 0.20 to 0.23 units for patients younger than 78 years of age (Group 1 and Group 3), and 0.28 to 0.29 for patients older than 77 years of age (Group 2 and Group 4).

Increasing age was associated with lower discharge FIM ratings; for each additional year, discharge motor FIM ratings decreased by 0.03 to 0.28 units. Stronger effects were observed for older patients (Group 2 and Group 4).

Patients who lived alone prior to the stroke tended to have higher discharge motor FIM ratings (i.e., more independence). The increase in the discharge motor FIM rating for patients who lived alone ranged from 0.88 to 1.57. All estimated effects were less than 2 FIM units, and may not be clinically important.

Patients who experienced a ***hemorrhagic stroke*** may have had slightly lower discharge FIM ratings than patients with a non-hemorrhagic stroke. Statistically significant effects were found for Group 1, Group 2 and Group 3 in 1996, and Group 1, Group 2 and Group 3 in 1997. Estimated effects were strongest for young patients with severe disabilities (3.92 FIM units in 1996 and 3.90 FIM units in 1997) and older patients with severe disabilities (1.72 FIM units in 1996 and 2.59 FIM units in 1997).

Having a ***tier 3 comorbidity*** was associated with a lower discharge motor FIM rating (i.e., more dependence) for patients in Group 1, Group 2 and Group 3. The decrease in the motor FIM rating was less than 2 FIM units for all groups, and ranged from 0.79 to 1.53.

Patients who were white may have had slightly lower FIM scores than non-white patients, estimated effects ranged from -0.99 to -2.32.

Female patients may have had lower discharge motor FIM ratings. A significant effect was found for patients in Group 1, Group 2 and Group 3, but all were less than 2 FIM units.

Table F.25 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 108) and 77 Years of Age or Younger (Group 1), 1996 Stroke Database (n = 9,346)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	40.65	1.24	--	32.66	0.000	38.21	43.09
Onset time	-0.09	0.01	-0.07	-8.32	0.000	-0.11	-0.07
Admission motor FIM rating	0.58	0.01	0.53	61.49	0.000	0.56	0.59
Admission cognitive FIM rating	0.20	0.01	0.14	16.56	0.000	0.17	0.22
Type of stroke (hemorrhage = 1)	0.82	0.27	0.03	2.99	0.003	0.28	1.36
Tier 1 comorbidity (present =1)	0.07	1.28	0.00	0.06	0.955	-2.45	2.59
Tier 2 comorbidity (present =1)	-0.73	0.67	-0.01	-1.09	0.277	-2.05	0.59
Tier 3 comorbidity (present =1)	-1.21	0.29	-0.04	-4.17	0.000	-1.77	-0.64
Age	-0.04	0.01	-0.03	-3.38	0.001	-0.07	-0.02
Pre-hospital living alone (alone =1)	1.13	0.19	0.05	6.06	0.000	0.76	1.49
Median household income	0.00	0.00	0.00	-0.41	0.682	0.00	0.00
Sex (female = 1)	-0.22	0.17	-0.01	-1.30	0.193	-0.54	0.11
Race (white = 1)	-0.99	0.22	-0.04	-4.50	0.000	-1.43	-0.56
Volume of patients	0.00	0.00	-0.01	-0.93	0.350	0.00	0.00
County managed care penetration	0.83	0.52	0.01	1.61	0.108	-0.18	1.85
Rehabilitation setting (IRF =1 , SNF = 0)	1.25	0.46	0.02	2.73	0.006	0.35	2.14

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.26 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 108) and 78 Years of Age or Older (Group 2), 1996 Stroke Database (n = 7,175)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	46.34	2.22	--	20.92	0.000	42.00	50.69
Onset time	-0.11	0.01	-0.08	-7.87	0.000	-0.13	-0.08
Admission motor FIM rating	0.63	0.01	0.51	53.14	0.000	0.60	0.65
Admission cognitive FIM rating	0.28	0.01	0.19	20.18	0.000	0.25	0.31
Type of stroke (hemorrhage = 1)	-0.38	0.34	-0.01	-1.13	0.259	-1.04	0.28
Tier 1 comorbidity (present =1)	-0.15	2.24	0.00	-0.07	0.945	-4.55	4.24
Tier 2 comorbidity (present =1)	-0.92	0.88	-0.01	-1.05	0.296	-2.65	0.81
Tier 3 comorbidity (present =1)	-1.05	0.41	-0.02	-2.57	0.010	-1.84	-0.25
Age	-0.18	0.02	-0.08	-7.85	0.000	-0.23	-0.14
Pre-hospital living alone (alone =1)	1.43	0.20	0.07	7.05	0.000	1.04	1.83
Median household income	0.00	0.00	0.02	2.32	0.020	0.00	0.00
Sex (female = 1)	-0.52	0.20	-0.03	-2.55	0.011	-0.92	-0.12
Race (white = 1)	-0.66	0.34	-0.02	-1.93	0.053	-1.33	0.01
Volume of patients	0.00	0.00	-0.01	-0.50	0.619	0.00	0.00
County managed care penetration	0.04	0.61	0.00	0.07	0.948	-1.16	1.24
Rehabilitation setting (IRF =1 , SNF = 0)	0.97	0.44	0.02	2.19	0.028	0.10	1.85

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.27 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 109 to 114) and 77 Years of Age or Younger (Group 3), 1996 Stroke Database (n = 7,466)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	16.83	1.98	--	8.50	0.000	12.95	20.70
Onset time	-0.08	0.02	-0.04	-4.88	0.000	-0.11	-0.05
Admission motor FIM rating	1.22	0.02	0.59	59.62	0.000	1.18	1.26
Admission cognitive FIM rating	0.21	0.02	0.10	10.62	0.000	0.17	0.24
Type of stroke (hemorrhage = 1)	3.92	0.45	0.08	8.80	0.000	3.04	4.79
Tier 1 comorbidity (present =1)	3.49	1.56	0.02	2.23	0.025	0.43	6.55
Tier 2 comorbidity (present =1)	-2.66	0.93	-0.03	-2.87	0.004	-4.48	-0.84
Tier 3 comorbidity (present =1)	-1.53	0.46	-0.03	-3.37	0.001	-2.43	-0.64
Age	-0.12	0.02	-0.05	-5.17	0.000	-0.17	-0.08
Pre-hospital living alone (alone =1)	0.35	0.35	0.01	1.00	0.317	-0.34	1.04
Median household income	0.00	0.00	0.01	1.50	0.135	0.00	0.00
Sex (female = 1)	-1.09	0.30	-0.03	-3.68	0.000	-1.67	-0.51
Race (white = 1)	-1.64	0.37	-0.04	-4.48	0.000	-2.36	-0.92
Volume of patients	0.00	0.00	-0.01	-1.46	0.145	0.00	0.00
County managed care penetration	-1.31	0.92	-0.01	-1.43	0.154	-3.12	0.49
Rehabilitation setting (IRF =1 , SNF = 0)	4.95	0.74	0.06	6.70	0.000	3.50	6.40

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.28 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older (Group 4), 1996 Stroke Database (n = 6,358)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	26.70	3.06	--	8.72	0.000	20.69	32.70
Onset time	-0.08	0.02	-0.04	-4.60	0.000	-0.11	-0.05
Admission motor FIM rating	1.30	0.02	0.63	63.27	0.000	1.26	1.34
Admission cognitive FIM rating	0.29	0.02	0.14	14.24	0.000	0.25	0.33
Type of stroke (hemorrhage = 1)	1.72	0.50	0.03	3.45	0.001	0.74	2.70
Tier 1 comorbidity (present =1)	0.72	2.05	0.00	0.35	0.724	-3.29	4.73
Tier 2 comorbidity (present =1)	-0.39	1.06	0.00	-0.37	0.712	-2.47	1.69
Tier 3 comorbidity (present =1)	-0.94	0.53	-0.02	-1.80	0.073	-1.97	0.09
Age	-0.28	0.03	-0.07	-8.02	0.000	-0.35	-0.21
Pre-hospital living alone (alone =1)	1.02	0.32	0.03	3.18	0.001	0.39	1.65
Median household income	0.00	0.00	0.00	-0.26	0.796	0.00	0.00
Sex (female = 1)	-1.53	0.31	-0.04	-4.90	0.000	-2.14	-0.92
Race (white = 1)	-1.45	0.45	-0.03	-3.25	0.001	-2.32	-0.57
Volume of patients	0.00	0.00	0.00	-0.05	0.958	0.00	0.00
County managed care penetration	-0.49	0.92	0.00	-0.53	0.599	-2.30	1.32
Rehabilitation setting (IRF =1 , SNF = 0)	2.60	0.62	0.04	4.16	0.000	1.37	3.82

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.29 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 77 Years of Age or Younger (Group 1), 1997 Stroke Database (n = 8,552)

Variable	Unstandardized Coefficients		Standardized	t	P	95% CI of Coefficient (β)	
	β	Std. Error	β			Lower Bound	Upper Bound
Intercept	37.50	1.28	--	29.24	0.000	34.98	40.01
Onset time	-0.10	0.01	-0.08	-8.48	0.000	-0.12	-0.08
Admission motor FIM rating	0.59	0.01	0.52	57.69	0.000	0.57	0.61
Admission cognitive FIM rating	0.23	0.01	0.16	18.08	0.000	0.20	0.25
Type of stroke (hemorrhage = 1)	1.26	0.29	0.04	4.28	0.000	0.68	1.83
Tier 1 comorbidity (present =1)	0.00	1.35	0.00	0.00	0.998	-2.66	2.65
Tier 2 comorbidity (present =1)	-1.63	0.70	-0.02	-2.34	0.019	-3.00	-0.27
Tier 3 comorbidity (present =1)	-1.26	0.30	-0.04	-4.20	0.000	-1.85	-0.67
Age	-0.03	0.01	-0.02	-1.99	0.046	-0.05	0.00
Pre-hospital living alone (alone =1)	1.39	0.20	0.06	7.03	0.000	1.00	1.77
Median household income	0.00	0.00	0.00	0.36	0.719	0.00	0.00
Sex (female = 1)	-0.30	0.18	-0.02	-1.70	0.089	-0.66	0.05
Race (white = 1)	-0.83	0.23	-0.03	-3.55	0.000	-1.29	-0.37
Volume of patients	0.00	0.00	-0.01	-0.56	0.578	0.00	0.00
County managed care penetration	0.72	0.57	0.01	1.26	0.207	-0.40	1.84
Rehabilitation setting (IRF =1 , SNF = 0)	1.28	0.41	0.03	3.17	0.002	0.49	2.08

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.30 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 101 to 107) and 78 Years of Age or Older (Group 2), 1997 Stroke Database (n = 6,930)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	48.53	2.21	--	21.97	0.000	44.20	52.86
Onset time	-0.08	0.01	-0.06	-5.80	0.000	-0.11	-0.05
Admission motor FIM rating	0.63	0.01	0.51	51.69	0.000	0.61	0.66
Admission cognitive FIM rating	0.29	0.01	0.20	20.67	0.000	0.26	0.32
Type of stroke (hemorrhage = 1)	-0.01	0.35	0.00	-0.03	0.979	-0.70	0.68
Tier 1 comorbidity (present =1)	0.36	1.75	0.00	0.20	0.839	-3.08	3.79
Tier 2 comorbidity (present =1)	-0.47	0.91	0.00	-0.52	0.605	-2.25	1.31
Tier 3 comorbidity (present =1)	-0.79	0.39	-0.02	-2.00	0.045	-1.56	-0.02
Age	-0.21	0.02	-0.09	-8.92	0.000	-0.26	-0.16
Pre-hospital living alone (alone =1)	1.53	0.21	0.08	7.46	0.000	1.13	1.94
Median household income	0.00	0.00	0.00	-0.28	0.779	0.00	0.00
Sex (female = 1)	-0.52	0.21	-0.02	-2.49	0.013	-0.92	-0.11
Race (white = 1)	-1.51	0.34	-0.04	-4.47	0.000	-2.17	-0.85
Volume of patients	0.00	0.00	0.00	0.45	0.654	0.00	0.00
County managed care penetration	0.28	0.62	0.00	0.45	0.650	-0.94	1.50
Rehabilitation setting (IRF =1 , SNF = 0)	0.86	0.35	0.03	2.49	0.013	0.18	1.54

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.31 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Severe Disability (Case-Mix Groups 108 to 114) and 77 Years of Age or Younger (Group 3), 1997 Stroke Database (n = 6,623)

Variable	Unstandardized Coefficients		Standardized β	t	P	95% CI of Coefficient (β)	
	β	Std. Error				Lower Bound	Upper Bound
Intercept	15.97	2.09	--	7.63	0.000	11.86	20.07
Onset time	-0.05	0.02	-0.03	-2.95	0.003	-0.08	-0.02
Admission motor FIM rating	1.23	0.02	0.59	56.36	0.000	1.19	1.27
Admission cognitive FIM rating	0.21	0.02	0.11	10.25	0.000	0.17	0.25
Type of stroke (hemorrhage = 1)	3.90	0.46	0.08	8.54	0.000	3.01	4.80
Tier 1 comorbidity (present =1)	2.36	1.79	0.01	1.32	0.187	-1.15	5.88
Tier 2 comorbidity (present =1)	-1.78	0.93	-0.02	-1.92	0.055	-3.60	0.04
Tier 3 comorbidity (present =1)	-1.22	0.48	-0.02	-2.55	0.011	-2.15	-0.28
Age	-0.11	0.03	-0.04	-4.25	0.000	-0.16	-0.06
Pre-hospital living alone (alone =1)	0.88	0.37	0.02	2.35	0.019	0.15	1.60
Median household income	0.00	0.00	0.02	1.61	0.108	0.00	0.00
Sex (female = 1)	-1.36	0.32	-0.04	-4.26	0.000	-1.98	-0.73
Race (white = 1)	-2.32	0.39	-0.06	-5.94	0.000	-3.09	-1.56
Volume of patients	0.00	0.00	0.00	-0.19	0.853	0.00	0.00
County managed care penetration	-0.89	0.98	-0.01	-0.90	0.366	-2.82	1.04
Rehabilitation setting (IRF =1 , SNF = 0)	3.40	0.67	0.05	5.10	0.000	2.09	4.70

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Table F.32 Multiple Linear Regression Analysis of Discharge Motor FIM Ratings for Covariates and Rehabilitation Setting for Patients with Mild to Moderate Disability (Case-Mix Groups 108 to 114) and 78 Years of Age or Older (Group 4), 1997 Stroke Database (n = 6,274)

Variable	Unstandardized Coefficients		Stand-ardized	t	P	95% CI of Coefficient (β)	
	β	Std. Error	β			Lower Bound	Upper Bound
Intercept	25.16	3.14	--	8.02	0.000	19.01	31.30
Onset time	-0.09	0.02	-0.04	-4.67	0.000	-0.12	-0.05
Admission motor FIM rating	1.30	0.02	0.62	61.84	0.000	1.26	1.34
Admission cognitive FIM rating	0.28	0.02	0.14	13.54	0.000	0.24	0.32
Type of stroke (hemorrhage = 1)	2.59	0.50	0.05	5.19	0.000	1.61	3.57
Tier 1 comorbidity (present =1)	1.14	2.01	0.01	0.57	0.570	-2.80	5.08
Tier 2 comorbidity (present =1)	0.90	1.03	0.01	0.87	0.382	-1.12	2.92
Tier 3 comorbidity (present =1)	-0.78	0.53	-0.01	-1.48	0.138	-1.81	0.25
Age	-0.26	0.04	-0.07	-7.34	0.000	-0.33	-0.19
Pre-hospital living alone (alone =1)	1.57	0.33	0.04	4.73	0.000	0.92	2.23
Median household income	0.00	0.00	0.02	2.48	0.013	0.00	0.00
Sex (female = 1)	-1.48	0.33	-0.04	-4.54	0.000	-2.12	-0.84
Race (white = 1)	-0.63	0.47	-0.01	-1.34	0.180	-1.54	0.29
Volume of patients	0.00	0.00	0.01	1.40	0.162	0.00	0.00
County managed care penetration	-0.87	0.96	-0.01	-0.91	0.364	-2.75	1.01
Rehabilitation setting (IRF =1 , SNF = 0)	0.82	0.53	0.02	1.55	0.122	-0.22	1.87

P refers to probability; CI, confidence interval; FIM, Functional Independence Measure; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility.

Appendix G:
Procedures Used to Assess for Potential Bias Due to Methodology

Procedures Used to Assess for Potential Biases Due to Methodology

As reported in the methods section, between 71 and 81 percent of records within facilities were linked. To determine whether the study methodology, including the linkage procedures, introduced a bias, the UDSMR data were analyzed and the results of the UDSMR and the linked UDSMR/MedPAR data were compared.

The analyses began with the creation of 4 UDSMR databases:

1) UDSMR records of patients with hip fracture who were admitted and discharged in 1996, and who had Medicare fee-for-service as a primary payer.
2) UDSMR records of patients with hip fracture who were admitted and discharged in 1997, and who had Medicare fee-for-service as a primary payer.
3) UDSMR records of patients with stroke who were admitted and discharged in 1996, and who had Medicare fee-for-service as a primary payer.
4) UDSMR records of patients with stroke who were admitted and discharged in 1997, and who had Medicare fee-for-service as a primary payer.

Each UDSMR database was split into the same 4 groups as the UDSMR/MedPAR linked databases.

Logistic regression and multiple linear regression analyses were run on the UDSMR data using the same transformed covariates used for the linked data.

Regression estimates would be expected to vary slightly[113] when a subset of data records was compared to the larger group of data records. In addition, there were some differences between UDSMR and linked UDSMR/MedPAR databases. For example, the records of patients with missing birth dates and discharge destinations were excluded from the UDSMR databases; these records may have been included in the linked database since MedPAR data may have been used as a substitute for missing UDSMR data.

For the logistic regression analyses, a difference of less than 15 percent between the estimated odd ratios based on the UDSMR data and the linked data was considered "not different." It the results were different, the direction of the difference was classified as: 1) toward the null (i.e., closer to the odds ratio of 1.0), 2) away from the null (i.e., further away from the odds ratio of 1.0), or 3) switchover, when one value was below 1.00, and the other was above 1.00.

For the multiple linear regression analyses, a difference of ± 0.75 FIM units between the estimated unstandardized betas derived from the UDSMR data and the linked data was considered "not different." If the results were different, the direction of the difference was classified as: 1) toward the null (i.e., closer to the difference of 0.0), 2) away from the null (i.e., further away from the difference of 0.0), or 3) switchover, when one value was negative, and the other was positive.

If some differences were detected, and the directions of the differences were the same, then the methodology may have introduced a bias that altered estimates.

Logistic Regression Analyses, 1996 Hip Fracture Database (Table G.1)

As shown in Table G.1, for Group 1, the odds ratios switchover (i.e., one was below 1.00, and the other was above 1.00), but neither was significant. For Group 2, the odds ratio for the linked data (0.72) was closer to the null of 1.00 than the estimate for the UDSMR data (0.62). For Group 3 and Group 4, the odds ratio for the linked data was within ± 15 percent of the UDSMR estimate.

Multiple Linear Regression Analyses, 1996 Hip Fracture Database (Table G.2)

Table G.2 shows that for Group 1, Group 3 and Group 4, the unstandardized beta estimates for the linked data were within ± 0.75 FIM units. For Group 2, the unstandardized beta for the linked data (-1.35) was closer to the null of 0.0 than the estimate for the UDSMR data (-2.17).

Logistic Regression Analyses, 1997 Hip Fracture Database (Table G.3)

For all 4 groups, the odds ratios for the linked data was within ± 15 percent of the estimate derived from the UDSMR data (Table G.3).

Multiple Linear Regression Analyses, 1997 Hip Fracture Database (Table G.4)

Table G.4 shows that for Group 1, Group 3 and Group 4, the unstandardized beta estimates for the linked data were within ± 0.75 FIM units. For Group 2, the unstandardized beta for the linked data (-0.18) was closer to the null of 0.0 than the estimate for the UDSMR data (-0.95).

Logistic Regression Analyses, 1996 Stroke Database (Table G.5)

Table G.5 reports that for Group 1, the estimated odds ratio for the linked data (2.19) was directed away from the null of 1.00 when compared to the estimate for the UDSMR data (1.55). For Group 2, Group 3 and Group 4, the odds ratios for the linked data was within ± 15% of the estimate derived from the UDSMR data.

Multiple Linear Regression Analyses, 1996 Stroke Database (Table G.6)

As reported in Table G.6, for Group 1, the unstandardized beta for the linked data (1.77) was directed away from the null of 0.0 when compared to the estimate for the UDSMR data (0.77). For Group 2, the unstandardized betas for the linked data (1.16) and the UDSMR data switchover (-0.26). For Group 3, the unstandardized beta for the linked data and UDSMR data were within ± 0.75 FIM

units. For Group 4, the unstandardized beta for the linked data (3.65) was farther away from the null of 0.0 than the estimate for the UDSMR data (2.71).

Logistic Regression Analyses, 1997 Stroke Database (Table G.7)

For all 4 groups, the odds ratios for the linked data were within ± 15 percent of the estimate derived from the UDSMR data (Table G.7).

Multiple Linear Regression Analyses, 1997 Stroke Database (Table G.8)

For all 4 group, the unstandardized beta for the linked data and UDSMR data were within ± 0.75 FIM units (Table G.8).

Table G.1 Logistic Regression Estimates of Effect of Rehabilitation Setting on Likelihood of Community-Based Discharge for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Hip Fracture, 1996

Group	Variable	UDSMR Records Exclusion Criteria Applied, and Adjusted for Covariates	Linked Records: Exclusion Criteria Applied, and Adjusted for Covariates
	Independent Variable	IRF = 1, SNF = 0	IRF = 1, SNF = 0
Group 1 Mild/Moderate Disability & ≤ 82 Years of Age	Number of IRF records	7,194	4,744
	Number of SNF records	703	591
	Odds ratio (95% CI)	0.85 (0.61 to 1.19)	1.02 (0.72 to 1.45)
	P	.335	.895
	Odds ratio estimates different?	Estimates switchover; both not significant	
Group 2 Mild/Moderate Disability & ≥ 83 Years of Age	Number of IRF records	3,989	2,844
	Number of SNF records	508	443
	Odds ratio (95% CI)	0.62 (0.49 to 0.84)	0.72 (0.51 to 1.00)
	P	.002	.050
	Odds ratio estimates different?	Estimate for linked data directed toward the null (1.00)	
Group 3: Severe Disability & ≤ 82 Years of Age	Number of IRF records	3,546	2,412
	Number of SNF records	466	379
	Odds ratio (95% CI)	0.80 (0.63 to 1.03)	0.73 (0.55 to 0.98)
	P	.077	.033
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	
Group 4: Severe Disability & ≥ 83 Years of Age	Number of IRF records	3,614	2,486
	Number of SNF records	648	558
	Odds ratio (95% CI)	0.77 (0.63 to 0.94)	0.80 (0.64 to 1.00)
	P	.010	.052
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	

UDSMR refers to the Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table G.2 Multiple Linear Regression Estimates of Effect of Rehabilitation Setting on Discharge Motor FIM Ratings for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Hip Fracture, 1996

Group	Variable	UDSMR Records Exclusion Criteria Applied, and Adjusted for Covariates	Linked Records: Exclusion Criteria Applied, and Adjusted for Covariates
	Independent Variable	IRF = 1, SNF = 0	IRF = 1, SNF = 0
Group 1 Mild/Moderate Disability & ≤ 82 Years of Age	Number of IRF records	7,194	4,744
	Number of SNF records	703	591
	β (95% CI)	-0.53 (-1.07 to -.001)	-0.75 (-1.34 to -0.15)
	P	.049	.014
	β estimates different?	Estimates within ± .75 FIM units	
Group 2 Mild/Moderate Disability & ≥ 83 Years of Age	Number of IRF records	3,989	2,844
	Number of SNF records	508	443
	β (95% CI)	-2.17 (-2.86 to 1.48)	-1.35 (-2.10 to -0.60)
	P	< .001	< .001
	β estimates different?	Estimate for linked data directed toward the null (0.0)	
Group 3: Severe Disability & ≤ 82 Years of Age	Number of IRF records	3,546	2,412
	Number of SNF records	466	379
	β (95% CI)	0.21 (-0.92 to 1.34)	0.26 (-1.04 to 1.56)
	P	.719	.695
	β estimates different?	Estimates within ± .75 FIM units	
Group 4: Severe Disability & ≥ 83 Years of Age	Number of IRF records	3,614	2,486
	Number of SNF records	648	558
	β (95% CI)	-0.23 (-1.21 to 0.74)	-0.18 (-1.27 to 0.90)
	P	.638	.739
	β estimates different?	Estimates within ± .75 FIM units	

FIM refers to Functional Independence Measure; UDSMR, Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table G.3 Logistic Regression Estimates of Effect of Rehabilitation Setting on Likelihood of Community-Based Discharge for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Hip Fracture, 1997

Group	Variable	UDSMR Records Exclusion Criteria Applied, and Adjusted for Covariates	Linked Records: Exclusion Criteria Applied, and Adjusted for Covariates
	Independent Variable	IRF = 1, SNF = 0	IRF = 1, SNF = 0
Group 1 Mild/Moderate Disability & ≤ 82 Years of Age	Number of IRF records	6,731	4,388
	Number of SNF records	1,094	889
	Odds ratio (95% CI)	.87 (.66 to 1.15)	0.90 (0.65 to 1.23)
	P	.326	.490
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	
Group 2 Mild/Moderate Disability & ≥ 83 Years of Age	Number of IRF records	3,742	2,669
	Number of SNF records	883	783
	Odds ratio (95% CI)	.76 (.60 to .94)	0.80 (0.62 to 1.02)
	P	.014	.073
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	
Group 3: Severe Disability & ≤ 82 Years of Age	Number of IRF records	3,756	2,514
	Number of SNF records	707	576
	Odds ratio (95% CI)	.89 (.73 to 1.09)	0.87 (0.69 to 1.10)
	P	.260	.246
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	
Group 4: Severe Disability & ≥ 83 Years of Age	Number of IRF records	3,759	2,657
	Number of SNF records	1,048	860
	Odds ratio (95% CI)	.76 (.64 to .89)	0.69 (0.57 to 0.83)
	P	.001	< .001
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	

UDSMR refers to the Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table G.4 Multiple Linear Regression Estimates of Effect of Rehabilitation Setting on Discharge Motor FIM Ratings for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Hip Fracture, 1997

Group	Variable	UDSMR Records Exclusion Criteria Applied, and Adjusted for Covariates	Linked Records: Exclusion Criteria Applied, and Adjusted for Covariates
	Independent Variable	IRF = 1, SNF = 0	IRF = 1, SNF = 0
Group 1 Mild/Moderate Disability & ≤ 82 Years of Age	Number of IRF records	6,731	4,388
	Number of SNF records	1,094	889
	β (95% CI)	-0.37 (-0.81 to 0.07)	0.04 (-0.47 to 0.54)
	P	.101	.893
	β estimates different?	Estimates within ± .75 FIM units	
Group 2 Mild/Moderate Disability & ≥ 83 Years of Age	Number of IRF records	3,742	2,669
	Number of SNF records	883	783
	β (95% CI)	-0.95 (-1.53 to -0.38)	-0.18 (-0.80 to 0.45)
	P	.001	.583
	β estimates different?	Estimate for linked directed toward the null (0.0)	
Group 3: Severe Disability & ≤ 82 Years of Age	Number of IRF records	3,756	2,514
	Number of SNF records	707	576
	β (95% CI)	0.78 (-0.17 to 1.73)	0.77 (-0.30 to 1.84)
	P	.106	.158
	β estimates different?	Estimates within ± .75 FIM units	
Group 4: Severe Disability & ≥ 83 Years of Age	Number of IRF records	3,759	2,657
	Number of SNF records	1,048	860
	β (95% CI)	-0.72 (-1.52 to 0.09)	-0.70 (-1.63 to 0.23)
	P	.081	.141
	β estimates different?	Estimates within ± .75 FIM units	

FIM refers to Functional Independence Measure; UDSMR, Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table G.5 Logistic Regression Estimates of Effect of Rehabilitation Setting on Likelihood of Community-Based Discharge for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Stroke, 1996

Group	Variable	UDSMR Records Exclusion Criteria Applied, and Adjusted for Covariates	Linked Records: Exclusion Criteria Applied, and Adjusted for Covariates
	Independent Variable	IRF = 1, SNF = 0	IRF = 1, SNF = 0
Group 1 Mild/Moderate Disability & ≤ 77 Years of Age	Number of IRF records	12,751	9,008
	Number of SNF records	396	338
	Odds ratio (95% CI)	1.55 (0.98 to 2.45)	2.19 (1.43 to 3.36)
	P	.062	< .001
	Odds ratio estimates different?	Estimate for linked data directed away from the null (1.00)	
Group 2 Mild/Moderate Disability & ≥ 78 Years of Age	Number of IRF records	9,333	6,781
	Number of SNF records	503	394
	Odds ratio (95% CI)	1.48 (1.06 to 2.07)	1.31 (0.96 to 1.80)
	P	.021	.092
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	
Group 3: Severe Disability & ≤ 77 Years of Age	Number of IRF records	10,518	7,131
	Number of SNF records	439	335
	Odds ratio (95% CI)	1.60 (1.19 to 2.14)	1.62 (1.23 to 2.13)
	P	.002	.001
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	
Group 4: Severe Disability & ≥ 78 Years of Age	Number of IRF records	8,405	5,918
	Number of SNF records	557	440
	Odds ratio (95% CI)	1.01 (0.78 to 1.30)	1.18 (0.92 to 1.51)
	P	.957	.199
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	

UDSMR refers to the Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table G.6 Multiple Linear Regression Estimates of Effect of Rehabilitation Setting on Discharge Motor FIM Ratings for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Stroke, 1996

Group	Variable	UDSMR Records Exclusion Criteria Applied, and Adjusted for Covariates	Linked Records: Exclusion Criteria Applied, and Adjusted for Covariates
	Independent Variable	IRF = 1, SNF = 0	IRF = 1, SNF = 0
Group 1 Mild/Moderate Disability & ≤ 77 Years of Age	Number of IRF records	12,751	9,008
	Number of SNF records	396	338
	β (95% CI)	0.77 (-0.25 to 1.79)	1.73 (0.79 to 2.67)
	P	.137	< .001
	β estimates different?	Linked estimate directed away from the null (0.0)	
Group 2 Mild/Moderate Disability & ≥ 78 Years of Age	Number of IRF records	9,333	6,781
	Number of SNF records	503	394
	β (95% CI)	-0.26 (-1.24 to 0.73)	1.16 (0.27 to 2.06)
	P	.610	.011
	β estimates different?	estimates switchover	
Group 3: Severe Disability & ≤ 77 Years of Age	Number of IRF records	10,518	7,131
	Number of SNF records	439	335
	β (95% CI)	5.33 (3.62 to 7.04)	6.03 (4.44 to 7.62)
	P	< .001	< .001
	β estimates different?	Estimates within ± .75 FIM units	
Group 4: Severe Disability & ≥ 78 Years of Age	Number of IRF records	8,405	5,918
	Number of SNF records	557	440
	β (95% CI)	2.71 (1.25 to 4.17)	3.65 (2.27 to 5.02)
	P	< .001	< .001
	β estimates different?	Linked estimate directed away from the null (0.0)	

FIM refers to Functional Independence Measure; UDSMR, Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table G.7 Logistic Regression Estimates of Effect of Rehabilitation Setting on Likelihood of Community-Based Discharge for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Stroke, 1997

Group	Variable	UDSMR Records Exclusion Criteria Applied, and Adjusted for Covariates	Linked Records: Exclusion Criteria Applied, and Adjusted for Covariates
	Independent Variable	IRF = 1, SNF = 0	IRF = 1, SNF = 0
Group 1 Mild/Moderate Disability & ≤ 77 Years of Age	Number of IRF records	12,605	8,083
	Number of SNF records	623	469
	Odds ratio (95% CI)	1.48 (1.08 to 2.04)	1.22 (0.83 to 1.79)
	P	.015	.317
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	
Group 2 Mild/Moderate Disability & ≥ 78 Years of Age	Number of IRF records	9,430	6,221
	Number of SNF records	881	709
	Odds ratio (95% CI)	1.57 (1.25 to 1.99)	1.52 (1.16 to 1.98)
	P	< .001	.002
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	
Group 3: Severe Disability & ≤ 77 Years of Age	Number of IRF records	10,050	6,186
	Number of SNF records	658	437
	Odds ratio (95% CI)	1.43 (1.18 to 1.74)	1.41 (1.11 to 1.80)
	P	< .001	.005
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	
Group 4: Severe Disability & ≥ 78 Years of Age	Number of IRF records	8,539	5,586
	Number of SNF records	886	688
	Odds ratio (95% CI)	1.18 (0.99 to 1.40)	0.92 (0.76 to 1.12)
	P	.055	.420
	Odds ratio estimates different?	Estimate for linked data within ± 15% of estimate for UDSMR data	

UDSMR refers to the Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table G.8 Multiple Linear Regression Estimates of Effect of Rehabilitation Setting on Discharge Motor FIM Ratings for UDSMR Records and Linked (MedPAR/UDSMR) Records, Patients with Stroke, 1997

Group	Variable	UDSMR Records Exclusion Criteria Applied, and Adjusted for Covariates	Linked Records: Exclusion Criteria Applied, and Adjusted for Covariates
	Independent Variable	IRF = 1, SNF = 0	IRF = 1, SNF = 0
Group 1 Mild/Moderate Disability & ≤ 77 Years of Age	Number of IRF records	12,605	8,083
	Number of SNF records	623	469
	β (95% CI)	1.54 (0.82 to 2.26)	1.49 (0.66 to 2.33)
	P	< .001	< .001
	β estimates different?	Estimates within ± .75 FIM units	
Group 2 Mild/Moderate Disability & ≥ 78 Years of Age	Number of IRF records	9,430	6,221
	Number of SNF records	881	709
	β (95% CI)	1.11 (0.45 to 1.76)	1.22 (0.49 to 1.96)
	P	< .001	.001
	β estimates different?	Estimates within ± .75 FIM units	
Group 3: Severe Disability & ≤ 77 Years of Age	Number of IRF records	10,050	6,186
	Number of SNF records	658	437
	β (95% CI)	4.42 (3.27 to 5.57)	4.17 (2.75 to 5.58)
	P	< .001	< .001
	β estimates different?	Estimates within ± .75 FIM units	
Group 4: Severe Disability & ≥ 78 Years of Age	Number of IRF records	8,539	5,586
	Number of SNF records	886	688
	β (95% CI)	2.01 (1.04 to 2.98)	1.48 (0.38 to 2.59)
	P	< .001	.008
	β estimates different?	Estimates within ± .75 FIM units	

FIM refers to Functional Independence Measure; UDSMR, Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Appendix H
Procedures Used to Assess for Potential Bias Due to Exclusion Criteria

Procedures Used to Assess for Potential Biases Due to Exclusion Criteria

As reported in the methods section, this study included the records of patients who had typical (i.e., complete and uninterrupted) rehabilitation stays. Patients who were admitted from another rehabilitation facility, as well as patients who were discharged to acute care, patients who died and patients who had program interruptions were not included in the analyses. The percent of records excluded from analyses ranged from 13.9 percent of records for patients with hip fractures admitted to IRFs in 1996 to 33.3 percent of records for patients with stroke admitted to SNFs in 1996.

To determine whether an alternative set of exclusion criteria would have led to different results, additional analyses of the UDSMR/MedPAR linked data were executed with 2 sets of alternative exclusion criteria. Results of the study based on the Original Study Exclusion Criteria (i.e., excluding "atypical" stays), and results using the 2 sets of alternative exclusion criteria were compared.

The first set of alternative exclusion criteria, referred to as Exclusion Criteria A, was the same as the Original Study Exclusion Criteria, except that it included the records of patients who had program interruptions, patients who died, and patients who were discharged to acute care hospitals. For the Exclusion Criteria A analyses, the discharge motor FIM ratings of patients who died were recoded

to 13 (i.e., dependent in all motor activities), and the discharge setting was coded as non-community.

The second set of alternative exclusion criteria, called Exclusion Criteria B, applied the study exclusion criteria, with the additional exclusion of patients who were younger than 65. Individuals younger than 65 who were Medicare beneficiaries had a long-term disability or renal failure.

Logistic regression analyses were run for each of the 4 groups using each of the 4 databases, first applying Exclusion Criteria A and then applying Exclusion Criteria B.

Regression estimates for the alternative exclusion criteria were expected to vary slightly from the Study Exclusion Criteria. For the logistic regression analyses, a difference of less than 15 percent between the estimated odd ratios calculated using Original Study Exclusion Criteria and the alternative exclusion criteria was considered "not different." If the results were different, the direction of the difference was classified as: 1) toward the null (i.e., closer to the odds ratio of 1.0), 2) away from the null (i.e., directed away from the odds ratio of 1.0), or 3) switchover, when one value was below 1.00, and the other was above 1.00.

For the multiple linear regression analyses, a difference of ± 0.75 FIM units between the estimated unstandardized betas derived using the Study Exclusion

Criteria and using one set of alternative exclusion criteria was considered "not different." It the results were different, the direction of the difference was classified as: 1) toward the null (i.e., closer to the difference of 0.0), 2) away from the null (i.e., further away from the difference of 0.0), or 3) switchover, when one value was negative, and the other was positive.

Logistic Regression Analyses, 1996 Hip Fracture Database (Table H.1)

Study Exclusion Criteria and Exclusion Criteria A

As reported in Table H.1, for Group 2, the estimated odds ratio using the Study Exclusion Criteria (0.72) was farther away from the null of 1.00 than was the estimate for Exclusion Criteria A (0.96). For Group 1, Group 3 and Group 4, the odds ratios using the Study Exclusion Criteria were within ± 15 percent of the corresponding estimates derived from the data using Exclusion Criteria A.

Study Exclusion Criteria and Exclusion Criteria B

For Group 1 and Group 3, the odds ratios for the Study Exclusion Criteria were within ± 15 percent of the corresponding estimates derived from the data using Exclusion Criteria A. Comparisons between Group 2 and Group 4 were not necessary, because these groups did not include the records of any patients younger than 65.

Multiple Linear Regression Analyses, 1996 Hip Fracture Database (Table H.2)

Study Exclusion Criteria and Exclusion Criteria A

Table H.2 shows that the unstandardized beta estimates for the data using the Study Exclusion Criteria and data using the Exclusion Criteria A were within ± 0.75 FIM units for all 4 groups.

Study Exclusion Criteria and Exclusion Criteria B

For Group 1 and Group 3, the unstandardized beta coefficients using the Study Exclusion Criteria were within ± 0.75 FIM units of the corresponding estimates derived using Exclusion Criteria B. Comparisons between Group 2 and Group 4 were not necessary, because these groups did not include the records of any patients younger than 65.

Logistic Regression Analyses, 1997 Hip Fracture Database (Table H.3)

Study Exclusion Criteria and Exclusion Criteria A

As reported in Table H.3, for Group 1, the estimated odds ratio using the Study Exclusion Criteria (0.90) and the estimate using Exclusion Criteria A (1.02) switchover, but both estimates were non-significant. For Group 2, Group 3 and Group 4, the odds ratios using the Study Exclusion Criteria were within ± 15

percent of the corresponding estimates derived from the data using Exclusion Criteria A.

Study Exclusion Criteria and Exclusion Criteria B

For Group 1 and Group 3, the odds ratios using the Study Exclusion Criteria were within ± 15 percent of the corresponding estimates derived from the data using Exclusion Criteria A. Comparisons between Group 2 and Group 4 were not necessary, because these groups did not include the records of any patients younger than 65.

Multiple Linear Regression Analyses, 1997 Hip Fracture Database (Table H.4)

Study Exclusion Criteria and Exclusion Criteria A

Table H.4 shows that the unstandardized beta estimates for the data using the Study Exclusion Criteria and the Exclusion Criteria A were within ± 0.75 FIM units for all 4 groups.

Study Exclusion Criteria and Exclusion Criteria B

For both groups, the unstandardized beta coefficients for the Study Exclusion Criteria were within ± 0.75 FIM units of the corresponding estimates derived using Exclusion Criteria B.

Logistic Regression Analyses, 1996 Stroke Database (Table H.5)

Study Exclusion Criteria and Exclusion Criteria A

Table H.5 reports that for Group 1, the estimated odds ratio for the data using the Study Exclusion Criteria (2.19) was directed away from the null of 1.00 when compared to the estimate for the data using Exclusion Criteria A (1.79).

For Group 2, Group 3 and Group 4, the odds ratios for the data using the Study Exclusion Criteria were within ± 15 percent of the corresponding estimates derived from the data using Exclusion Criteria A.

Study Exclusion Criteria and Exclusion Criteria B

For Group 1 and Group 3, the odds ratios for the Study Exclusion Criteria were within ± 15 percent of the corresponding estimates derived from the data using Exclusion Criteria A.

Multiple Linear Regression Analyses, 1996 Stroke Database (Table H.6)

Study Exclusion Criteria and Exclusion Criteria A

Table H.6 shows that the unstandardized beta estimates for the data using the Study Exclusion Criteria and the Exclusion Criteria A were within ± 0.75 FIM units for all 4 groups.

Study Exclusion Criteria and Exclusion Criteria B

For Group 1 and Group 3, the unstandardized beta coefficients for the Study Exclusion Criteria were within ± 0.75 FIM units of the corresponding estimates derived using Exclusion Criteria B.

Logistic Regression Analyses, 1997 Stroke Database (Table H.7)

Study Exclusion Criteria and Exclusion Criteria A

Table H.7 reports that for Group 2, the estimated odds ratio for the data using the Study Exclusion Criteria (1.52) was directed away from the null of 1.00 when compared to the estimate for the data using Exclusion Criteria A (1.30). For Group 1, Group 3 and Group 4, the odds ratios for the data using the Study Exclusion Criteria were within ± 15 percent of the corresponding estimates derived from the data using Exclusion Criteria A.

Study Exclusion Criteria and Exclusion Criteria B

For Group 1 and Group 3, the odds ratios for the Study Exclusion Criteria were within ± 15% of the corresponding estimates derived from the data using Exclusion Criteria A. Comparisons between Group 2 and Group 4 were not necessary, because these groups did not include the records of any patients younger than 65.

Multiple Linear Regression Analyses, 1997 Stroke Database (Table H.8)

Study Exclusion Criteria and Exclusion Criteria A

Table H.8 shows that the unstandardized beta estimates for the data using the Study Exclusion Criteria and the Exclusion Criteria A were within ± 0.75 FIM units for all 4 groups.

Study Exclusion Criteria and Exclusion Criteria B

For Group 1 and Group 3, the unstandardized beta coefficients for the Study Exclusion Criteria were within ± 0.75 FIM units of the corresponding estimates derived using Exclusion Criteria B. Comparisons between Group 2 and Group 4 were not necessary, because these groups did not include the records of any patients younger than 65.

Table H.1 Logistic Regression Estimates of Effects of Rehabilitation Setting (IRF = 1, SNF = 0) on Likelihood of Community-Based Discharge for Various Exclusion Criteria, Patients with Hip Fracture, 1996

Group	Variable	Linked Records: Study Exclusion Criteria Applied	Linked Records: Exclusion Criteria A Applied	Linked Records: Exclusion Criteria B Applied
Group 1: Mild/Moderate Disability & ≤ 82 Years of Age	Number of IRF records	4,744	4,935	4,542
	Number of SNF records	591	618	577
	Odds ratio (95% CI)	1.02 (0.72 to 1.45)	1.10 (0.82 to 1.48)	1.04 (0.73 to 1.48)
	P	.895	.522	.851
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Estimates within ± 15%
Group 2: Mild/Moderate Disability & ≥ 83 Years of Age	Number of IRF records	2,844	2,967	2,844
	Number of SNF records	443	486	443
	Odds ratio (95% CI)	0.72 (0.51 to 1.00)	0.96 (0.72 to 1.26)	0.72 (0.51 to 1.00)
	P	.050	.743	.050
	Estimates different?	Study exclusion criteria	Study exclusion criteria OR directed away from null	Not applicable; no patients ≤ 65 years
Group 3: Severe Disability & ≤ 82 Years of Age	Number of IRF records	2,412	2,625	2,292
	Number of SNF records	379	429	370
	Odds ratio (95% CI)	0.73 (0.55 to 0.98)	0.81 (0.63 to 1.04)	0.73 (0.54 to 0.98)
	P	.033	.103	.034
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Estimates within ± 15%
Group 4: Severe Disability & ≥ 83 Years of Age	Number of IRF records	2,486	2,716	2,486
	Number of SNF records	558	625	558
	Odds ratio (95% CI)	0.80 (0.64 to 1.00)	0.90 (0.73 to 1.10)	0.80 (0.64 to 1.00)
	P	.052	.301	.052
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Not applicable

UDSMR refers to the Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability; OR, Odds ratio.

Table H.2 Multiple Linear Regression Estimates of Effects of Rehabilitation Setting (IRF = 1, SNF = 0) on Discharge Motor FIM Ratings for Various Exclusion Criteria, Patients with Hip Fracture, 1996

Group	Variable	Linked Records: Study Exclusion Criteria Applied	Linked Records: Exclusion criteria A applied	Linked Records: Exclusion criteria B applied
Group 1: Mild/Moderate Disability & ≤ 82 Years of Age	Number of IRF records	4,744	4,935	4,542
	Number of SNF records	591	618	577
	β (95% CI)	-0.75 (-1.34 to -0.15)	-0.58 (-1.19 to 0.04)	-0.71 (-1.31 to -0.11)
	P	.014	.064	.021
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Estimates within ± 0.75 FIM units
Group 2: Mild/Moderate Disability & ≥ 83 Years of Age	Number of IRF records	2,844	2,967	2,844
	Number of SNF records	443	486	443
	β (95% CI)	-1.35 (-2.10 to -0.60)	-0.88 (-1.65 to -0.11)	-1.35 (-2.10 to -0.60)
	P	< .001	.026	< .001
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Not applicable;
Group 3: Severe Disability & ≤ 82 Years of Age	Number of IRF records	2,412	2,625	2,292
	Number of SNF records	379	429	370
	β (95% CI)	0.26 (-1.04 to 1.56)	0.84 (-0.44 to 2.12)	0.77 (-1.14 to 1.49)
	P	.695	.199	.793
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Estimates within ± 0.75 FIM units
Group 4: Severe Disability & ≥ 83 Years of Age	Number of IRF records	2,486	2,716	2,486
	Number of SNF records	558	625	558
	β (95% CI)	-0.18 (-1.27 to 0.90)	0.41 (-0.68 to 1.49)	-0.18 (-1.27 to 0.90)
	P	.739	.464	.739
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Not applicable; no patients ≤ 65 years

FIM refers to Functional Independence Measure; UDSMR, Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table H.3 Logistic Regression Estimates of Effects of Rehabilitation Setting (IRF = 1, SNF = 0) on Likelihood of Community-Based Discharge for Various Exclusion Criteria, Patients with Hip Fracture, 1997

Group	Variable	Linked Records: Study Exclusion Criteria Applied	Linked Records: Exclusion criteria A applied	Linked Records: Exclusion criteria B applied
Group 1: Mild/Moderate Disability & ≤ 82 Years of Age	Number of IRF records	4,388	4,553	4,220
	Number of SNF records	889	936	850
	Odds ratio (95% CI)	0.90 (0.65 to 1.23)	1.02 (0.79 to 1.32)	0.86 (0.62 to 1.19)
	P	.490	.881	.368
	Estimates different?	Study exclusion criteria	Estimates switchover; both not significant	Estimates within ± 15%
Group 2: Mild/Moderate Disability & ≥ 83 Years of Age	Number of IRF records	2,669	2,804	2,669
	Number of SNF records	783	824	783
	Odds ratio (95% CI)	0.80 (0.62 to 1.02)	0.82 (0.66 to 1.03)	0.80 (0.62 to 1.02)
	P	.073	.083	.072
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Not applicable; no patients ≤ 65 years
Group 3: Severe Disability & ≤ 82 Years of Age	Number of IRF records	2,514	2,757	2,400
	Number of SNF records	576	639	552
	Odds ratio (95% CI)	0.87 (0.69 to 1.10)	0.94 (0.77 to 1.16)	0.86 (0.68 to 1.09)
	P	.246	.577	.206
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Estimates within ± 15%
Group 4: Severe Disability & ≥ 83 Years of Age	Number of IRF records	2,657	2,876	2,657
	Number of SNF records	860	942	860
	Odds ratio (95% CI)	0.69 (0.57 to 0.83)	0.71 (0.60 to 0.85)	0.69 (0.57 to 0.83)
	P	< .001	< .001	< .001
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Not applicable

UDSMR refers to the Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table H.4 Multiple Linear Regression Estimates of Effects of Rehabilitation Setting (IRF = 1, SNF = 0) on Discharge Motor FIM Ratings for Various Exclusion Criteria, Patients with Hip Fracture, 1997

Group	Variable	Linked Records: Study Exclusion Criteria Applied	Linked Records: Exclusion criteria A applied	Linked Records: Exclusion criteria B applied
Group 1: Mild/Moderate Disability & ≤ 82 Years of Age	Number of IRF records	4,388	4,553	4,220
	Number of SNF records	889	936	850
	β (95% CI)	0.04 (-0.47 to 0.54)	0.11 (-0.42 to 0.64)	-0.18 (-0.70 to 0.34)
	P	.893	.683	.493
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Estimates within ± 0.75 FIM units
Group 2: Mild/Moderate Disability & ≥ 83 Years of Age	Number of IRF records	2,669	2,804	2,669
	Number of SNF records	783	824	783
	β (95% CI)	-0.17 (-0.80 to 0.45)	-.21 (-.85 to 0.44)	-0.17 (-0.80 to 0.45)
	P	.583	.530	.583
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Not applicable; no patients ≤ 65 yrs
Group 3: Severe Disability & ≤ 82 Years of Age	Number of IRF records	2,514	2,757	2,400
	Number of SNF records	576	639	552
	β (95% CI)	0.77 (-0.30 to 1.84)	1.40 (0.32 to 2.48)	0.61 (-0.49 to 1.71)
	P	.158	.011	.274
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Estimates within ± 0.75 FIM units
Group 4: Severe Disability & ≥ 83 Years of Age	Number of IRF records	2,657	2,876	2,657
	Number of SNF records	860	942	860
	β (95% CI)	-0.70 (-1.63 to 0.23)	-0.57 (-1.50 to 0.35)	-0.70 (-1.63 to 0.23)
	P	.141	.223	.141
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Not applicable

FIM refers to Functional Independence Measure; UDSMR, Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table H.5 Logistic Regression Estimates of Effects of Rehabilitation Setting (IRF = 1, SNF = 0) on Likelihood of Community-Based Discharge for Various Exclusion Criteria, Patients with Stroke, 1996

Group	Variable	Linked Records: Study Exclusion Criteria Applied	Linked Records: Exclusion criteria A applied	Linked Records: Exclusion criteria B applied
Group 1: Mild/Moderate Disability & ≤ 77 Years of Age	Number of IRF records	9,008	9,508	8,058
	Number of SNF records	338	360	305
	Odds ratio (95% CI)	2.19 (1.43 to 3.36)	1.79 (1.27 to 2.54)	1.96 (1.25 to 3.07)
	P	< .001	.001	.003
	Estimates different?	Study exclusion criteria	Study exclusion criteria OR directed away from null	Study exclusion criteria OR directed away from null
Group 2: Mild/Moderate Disability & ≥ 78 Years of Age	Number of IRF records	6,781	7,103	6,781
	Number of SNF records	394	435	394
	Odds ratio (95% CI)	1.31 (0.96 to 1.80)	1.54 (1.17 to 2.03)	1.31 (0.96 to 1.80)
	P	.092	.002	.092
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Not applicable; no patients ≤ 65 yrs
Group 3: Severe Disability & ≤ 77 Years of Age	Number of IRF records	7,131	8,044	6,389
	Number of SNF records	335	423	309
	Odds ratio (95% CI)	1.62 (1.23 to 2.13)	1.86 (1.46 to 2.58)	1.57 (1.17 to 2.09)
	P	.001	< .001	.002
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Estimates within ± 15%
Group 4: Severe Disability & ≥ 78 Years of Age	Number of IRF records	5,918	6,662	5,918
	Number of SNF records	440	529	440
	Odds ratio (95% CI)	1.18 (0.92 to 1.51)	1.32 (1.05 to 1.66)	1.18 (0.92 to 1.51)
	P	.199	.017	.199
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Not applicable; no patients ≤ 65 yrs

UDSMR refers to the Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability; OR, Odds ratio.

Table H.6 Multiple Linear Regression Estimates of Effects of Rehabilitation Setting (IRF = 1, SNF = 0) on Discharge Motor FIM Ratings for Various Exclusion Criteria, Patients with Stroke, 1996

Group	Variable	Linked Records: Study Exclusion Criteria Applied	Linked Records: Exclusion criteria A applied	Linked Records: Exclusion criteria B applied
Group 1: Mild/Moderate Disability & ≤ 77 Years of Age	Number of IRF records	9,008	9,508	8,058
	Number of SNF records	338	360	305
	β (95% CI)	1.73 (0.79 to 2.67)	1.75 (0.76 to 2.74)	1.75 (0.76 to 2.74)
	P	< .001	.001	.001
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Estimates within ± 0.75 FIM units
Group 2: Mild/Moderate Disability & ≥ 78 Years of Age	Number of IRF records	6,781	7,103	6,781
	Number of SNF records	394	435	394
	β (95% CI)	1.16 (0.27 to 2.06)	1.63 (0.70 to 2.57)	1.16 (0.27 to 2.06)
	P	.011	.001	.011
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Not applicable
Group 3: Severe Disability & ≤ 77 Years of Age	Number of IRF records	7,131	8,044	6,389
	Number of SNF records	335	423	309
	β (95% CI)	6.03 (4.44 to 7.62)	6.66 (5.16 to 8.16)	6.03 (4.44 to 7.62)
	P	< .001	< .001	< .001
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Estimates within ± 0.75 FIM units
Group 4: Severe Disability & ≥ 78 Years of Age	Number of IRF records	5,918	6,662	5,918
	Number of SNF records	440	529	440
	β (95% CI)	3.65 (2.27 to 5.02)	3.71 (2.40 to 5.02)	3.65 (2.27 to 5.02)
	P	< .001	< .001	< .001
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Not applicable; no patients ≤ 65 yrs

FIM refers to Functional Independence Measure; UDSMR, Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

Table H.7 Logistic Regression Estimates of Effects of Rehabilitation Setting (IRF = 1, SNF = 0) on Likelihood of Community-Based Discharge for Various Exclusion Criteria, Patients with Stroke, 1997

Group	Variable	Linked Records: Study Exclusion Criteria Applied	Linked Records: Exclusion criteria A applied	Linked Records: Exclusion criteria B applied
Group 1: Mild/Moderate Disability & ≤ 77 Years of Age	Number of IRF records	8,083	8,405	7,203
	Number of SNF records	469	501	426
	Odds ratio (95% CI)	1.22 (0.83 to 1.79)	1.29 (0.93 to 1.79)	1.23 (0.83 to 1.86)
	P	.317	.128	.292
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Estimates within ± 15%
Group 2: Mild/Moderate Disability & ≥ 78 Years of Age	Number of IRF records	6,221	6,473	6,221
	Number of SNF records	709	747	709
	Odds ratio (95% CI)	1.52 (1.16 to 1.98)	1.30 (1.01 to 1.66)	1.52 (1.16 to 1.98)
	P	.002	.038	.002
	Estimates different?	Study exclusion criteria	Study exclusion criteria OR directed away from null	Not applicable; no patients ≤ 65 years
Group 3: Severe Disability & ≤ 77 Years of Age	Number of IRF records	6,186	6,811	5,542
	Number of SNF records	437	542	413
	Odds ratio (95% CI)	1.41 (1.11 to 1.80)	1.61 (1.29 to 1.99)	1.33 (1.04 to 1.72)
	P	.005	< .001	.025
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Estimates within ± 15%
Group 4: Severe Disability & ≥ 78 Years of Age	Number of IRF records	5,586	6,091	5,586
	Number of SNF records	688	819	688
	Odds ratio (95% CI)	0.92 (0.76 to 1.12)	0.98 (0.82 to 1.18)	0.92 (0.76 to 1.12)
	P	.420	.846	.420
	Estimates different?	Study exclusion criteria	Estimates within ± 15%	Not applicable

UDSMR refers to the Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability; OR, Odds ratio.

Table H.8 Multiple Linear Regression Estimates of Effects of Rehabilitation Setting (IRF = 1, SNF = 0) on Discharge Motor FIM Ratings for Various Exclusion Criteria, Patients with Stroke, 1997

Group	Variable	Linked Records: Study Exclusion Criteria Applied	Linked Records: Exclusion criteria A applied	Linked Records: Exclusion criteria B applied
Group 1: Mild/Moderate Disability & ≤ 77 Years of Age	Number of IRF records	8,083	8,405	7,203
	Number of SNF records	469	501	426
	β (95% CI)	1.49 (0.66 to 2.33)	1.49 (0.62 to 2.35)	1.32 (0.44 to 2.20)
	P	< .001	.001	.003
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Estimates within ± 0.75 FIM units
Group 2: Mild/Moderate Disability & ≥ 78 Years of Age	Number of IRF records	6,221	6,473	6,221
	Number of SNF records	709	747	709
	β (95% CI)	1.22 (0.49 to 1.96)	1.16 (0.39 to 1.93)	1.22 (0.49 to 1.96)
	P	.001	.003	.001
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Not applicable; no patients ≤ 65 yrs
Group 3: Severe Disability & ≤ 77 Years of Age	Number of IRF records	6,186	6,811	5,542
	Number of SNF records	437	542	413
	β (95% CI)	4.17 (2.75 to 5.58)	4.77 (3.49 to 6.10)	3.88 (2.42 to 5.34)
	P	< .001	< .001	< .001
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Estimates within ± 0.75 FIM units
Group 4: Severe Disability & ≥ 78 Years of Age	Number of IRF records	5,586	6,091	5,586
	Number of SNF records	688	819	688
	β (95% CI)	1.48 (0.38 to 2.59)	1.55 (0.50 to 2.60)	1.48 (0.38 to 2.59)
	P	.008	.004	.008
	Estimates different?	Study exclusion criteria	Estimates within ± 0.75 FIM units	Not applicable

FIM refers to Functional Independence Measure; UDSMR, Uniform Data System for Medical Rehabilitation; MedPAR, Medicare Provider Analysis and Review record; IRF, Inpatient Rehabilitation Facility; SNF, Skilled Nursing Facility; CI, confidence interval; P, probability.

REFERENCES

1. Guterman S, Eggers PW, Riley G, Greene TF, Terrell SA. The first 3 years of Medicare prospective payment: an overview. *Health Care Financ Rev* 1988;9(3):67-77.

2. Kane RL, Finch M, Blewett L, Chen Q, Burns R, Moskowitz M. Use of post-hospital care by Medicare patients. *J Am Geriatr Soc* 1996;44(3):242-50.

3. Gornick M, Hall MJ. Trends in Medicare use of post-hospital care. *Health Care Financ Rev* 1988;Spec No:27-38.

4. Marciniak CM, Heinemann AW, Monga T. Changes in medical stability upon admission to a rehabilitation unit. *Arch Phys Med Rehabil* 1993;74(11):1157-60.

5. Marciniak CM, Sliwa JA, Spill G, Heinemann AW, Semik PE. Functional outcome following rehabilitation of the cancer patient. *Arch Phys Med Rehabil* 1996;77(1):54-7.

6. Berg K, Intrator O. Postacute care following stroke or hip fracture: single services and combinations used by Medicare beneficiaries (1987-1992). *J Aging Health* 1999;11(1):27-48.

7. Kane RL, Chen Q, Blewett LA, Sangl J. Do rehabilitative nursing homes improve the outcomes of care? *J Am Geriatr Soc* 1996;44(5):545-54.

8. Shaughnessy PW, Kramer AM. The increased needs of patients in nursing homes and patients receiving home health care. *N Engl J Med* 1990;322(1):21-7.

9. Lui K, Gage B, Harvell J, Stevenson D, Brennan N. *Medicare's Post-Acute Care Benefits: Background, Trends, and Issues to be Faced.* Washington, D.C.: The Urban Institute for the U.S. Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation, Office of Disability, Aging, and Long-Term Care Policy; 1999.

10. U.S. Department of Health and Human Services HCFA, Office of Strategic Planning. Health Care Financing Review, *Statistical Supplement*. Baltimore, MD: U.S. Department of Health and Human Services, Health Care Financing Administration, Office of Strategic Planning; 2000.

11. Kane R. *A Study of Post Acute Care. Final Report.* Minneapolis, MN: Institute for Health Services Research, University of Minnesota School of Public Health; 1994.

REFERENCES (cont'd)

12. Gage B. Impact of the BBA on Post-Acute Utilization. *Health Care Financ Rev* 1999;20(4):103-26.

13. Lee J, Huber J, Stason W. Factors Contributing to Practice Variation in Post-Stroke Rehabilitation. *Health Serv Res* 1997;32(2):197-221.

14. Medicare Payment Advisory Commission. *Report to the Congress: Context for a Changing Medicare Program.* Washington, D.C.: Medicare Payment Advisory Commission; 1998.

15. Retchin SM, Brown RS, Yeh SC, Chu D, Moreno L. Outcomes of stroke patients in Medicare fee for service and managed care. *JAMA* 1997;278(2):119-24.

16. Blewett LA, Kane RL, Finch M. Hospital ownership of post-acute care: does it increase access to post-acute care services? *Inquiry* 1995;32(4):457-67.

17. Keith RA, Wilson DB, Gutierrez P. Acute and subacute rehabilitation for stroke: a comparison. *Arch Phys Med Rehabil* 1995;76(6):495-500.

18. Kramer AM, Steiner JF, Schlenker RE, Eilertsen TB, Hrincevich CA, Tropea DA, et al. Outcomes and costs after hip fracture and stroke. A comparison of rehabilitation settings. *JAMA* 1997;277(5):396-404.

19. Post-Stroke Rehabilitation Guideline Panel. *Post-Stroke Rehabilitation: Clinical Practice Guideline.* Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research; 1995.

20. Garrison S, Rolak L. Rehabilitation of the Stroke Patient. In: DeLisa J, editor. *Rehabilitation Medicine: Principles and Practice.* Philadelphia, PA: J. B. Lippincott Company; 1993. p. 801-24.

21. U.S. Department of Health and Human Services CMS. *Hospital Manual.* Baltimore, MD: U.S. Department of Health and Human Services, Centers for Medicare and Medicaid Services; 2003. p. Section 211.

22. Prospective Payment Advisory Commission. *Medicare and the American Health Care System: Report to the Congress.* Washington, D.C.: Prospective Payment Assessment Commission; 1997.

REFERENCES (cont'd)

23. Health Care Financing Administration, U.S. Department of Health and Human Services. *Your Medicare Handbook 1997.* Baltimore, MD: U.S. Department of Health and Human Services, Public Health Service, Health Care Financing Administration; 1997.

24. Chan L, Houck P, Prela CM, MacLehose RF. Using Medicare databases for outcomes research in rehabilitation medicine. *Am J Phys Med Rehabil* 2001;80(6):474-80.

25. U.S. Department of Health and Human Services HCFA. Medicare Program; Prospective Payment System for Inpatient Rehabilitation Facilities; Final Rule. *Federal Register* 2001;66(152):41316-430.

26. Gill H. Subacute care in the inpatient setting. *Rehab Management* 1995:38-40.

27. Congressional Budget Office. *Projections of Expenditures for Long-Term Care Services for the Elderly.* Washington, D.C.: Congressional Budget Office; 1999.

28. Office of Disability, Aging and Long-Term Care Policy, Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services. *Post-Acute Care Issues for Medicare: Interviews with Provider and Consumer Groups, and Researchers and Policy Analysts.* Washington, D.C.: U.S. Department of Health and Human Services, Assistant Secretary for Planning and Evaluation, Office of Disability, Aging and Long-Term Care Policy; 2000.

29. Lui K. *Therapy Services Provided to SNF Patients Under Medicare Part B.* Washington, D.C.: The Urban Institute; 1993.

30. U.S. Department of Health and Human Services HCFA. Medicare Program; Prospective Payment System and Consolidated Billing for Skilled Nursing Facilities; Final Rule. *Federal Register* 1998;63(91):26252-316.

31. Koval KJ, Aharonoff GB, Su ET, Zuckerman JD. Effect of acute inpatient rehabilitation on outcome after fracture of the femoral neck or intertrochanteric fracture. *J Bone Joint Surg Am* 1998;80(3):357-64.

32. Salcido R, Moore R, Schleenbaker R, Klim G. The Physiatrist and Subacute Rehabilitation. *Clinical Rehabilitation and Physiatric Practice* 1996;7(1):55-81.

REFERENCES (cont'd)

33. Wolk S, Blair T. *Trends in Medical Rehabilitation*. Reston, VA: American Rehabilitation Association; 1994.

34. Wan T, Stegall M, Stegall S. Hip fracture and subacute service utilization of Medicare beneficiaries: trends and patterns. *J Rehabil Outcomes Meas* 1997;1(4):23-34.

35. Health Care Financing Administration, U.S. Department of Health and Human Services. *1997 HCFA Statistics*. Washington, D.C.: U.S. Department of Health and Human Services, Public Health Service, Health Care Financing Administration, Office of Strategic Planning; 1997.

36. Kane RL, Lin WC, Blewett LA. Geographic variation in the use of post-acute care. *Health Serv Res* 2002;37(3):667-82.

37. Kramer AM, Kowalsky JC, Lin M, Grigsby J, Hughes R, Steiner JF. Outcome and utilization differences for older persons with stroke in HMO and fee-for-service systems. J Am Geriatr Soc 2000;48(7):726-34.

38. Stevens J, Olsen S. Reducing falls and reducing hip fractures among older women. *Morbidity and Mortality Weekly Report* 2000;49(RR02):1-12.

39. Magaziner J, Simonsick EM, Kashner TM, Hebel JR, Kenzora JE. Predictors of functional recovery one year following hospital discharge for hip fracture: a prospective study. *J Gerontol* 1990;45(3):M101-7.

40. Eldar R, Isakov E. Rehabilitation of hip fractures. *Critical Reviews in Physical Medicine and Rehabilitation* 1998;10(1):1-13.

41. Jung P. Racial differences in hip fracture: a literature review. *Issues on Aging* 1997;20(2):13-16.

42. Koval KJ, Skovron ML, Aharonoff GB, Zuckerman JD. Predictors of functional recovery after hip fracture in the elderly. *Clin Orthop* 1998(348):22-8.

43. Cobey JC, Cobey JH, Conant L, Weil UH, Greenwald WF, Southwick WO. Indicators of recovery from fractures of the hip. *Clin Orthop* 1976(117):258-62.

44. Miller CW. Survival and ambulation following hip fracture. *J Bone Joint Surg Am* 1978;60(7):930-4.

REFERENCES (cont'd)

45. Ceder L, Thorngren KG, Wallden B. Prognostic indicators and early home rehabilitation in elderly patients with hip fractures. *Clin Orthop* 1980(152):173-84.

46. Nickens HW. A review of factors affecting the occurrence and outcome of hip fracture, with special reference to psychosocial issues. *J Am Geriatr Soc* 1983;31(3):166-70.

47. Barnes B. Ambulation outcomes after hip fracture. *Phys Ther* 1984;64(3):317-23.

48. Cheng CL, Lau S, Hui PW, Chow SP, Pun WK, Ng J, et al. Prognostic factors and progress for ambulation in elderly patients after hip fracture. *Am J Phys Med Rehabil* 1989;68(5):230-3.

49. Mossey JM, Mutran E, Knott K, Craik R. Determinants of recovery 12 months after hip fracture: the importance of psychosocial factors. *Am J Public Health* 1989;79(3):279-86.

50. Thorngren KG. Fractures in older persons. *Disabil Rehabil* 1994;16(3):119-26.

51. Jette AM, Harris BA, Cleary PD, Campion EW. Functional recovery after hip fracture. *Arch Phys Med Rehabil* 1987;68(10):735-40.

52. Cummings SR, Phillips SL, Wheat ME, Black D, Goosby E, Wlodarczyk D, et al. Recovery of function after hip fracture. The role of social supports. *J Am Geriatr Soc* 1988;36(9):801-6.

53. Marcantonio ER, Flacker JM, Michaels M, Resnick NM. Delirium is independently associated with poor functional recovery after hip fracture. *J Am Geriatr Soc* 2000;48(6):618-24.

54. Marcantonio ER, Simon SE, Bergmann MA, Jones RN, Murphy KM, Morris JN. Delirium Symptoms in Post-Acute Care: Prevalent, Persistent, and Associated with Poor Functional Recovery. *J Am Geriatr Soc* 2003;51(1):4-9.

55. Dolan MM, Hawkes WG, Zimmerman SI, Morrison RS, Gruber-Baldini AL, Hebel JR, et al. Delirium on hospital admission in aged hip fracture patients: prediction of mortality and 2-year functional outcomes. *J Gerontol A Biol Sci Med Sci* 2000;55(9):M527-34.

REFERENCES (cont'd)

56. Heruti RJ, Lusky A, Barell V, Ohry A, Adunsky A. Cognitive status at admission: does it affect the rehabilitation outcome of elderly patients with hip fracture? *Arch Phys Med Rehabil* 1999;80(4):432-6.

57. Goldstein FC, Strasser DC, Woodard JL, Roberts VJ. Functional outcome of cognitively impaired hip fracture patients on a geriatric rehabilitation unit. *J Am Geriatr Soc* 1997;45(1):35-42.

58. Burns RB, Moskowitz MA, Ash A, Kane RL, Finch M, McCarthy EP. Do hip replacements improve outcomes for hip fracture patients? *Med Care* 1999;37(3):285-94.

59. Lieberman D, Fried V, Castel H, Weitzmann S, Lowenthal MN, Galinsky D. Factors related to successful rehabilitation after hip fracture: a case-control study. *Disabil Rehabil* 1996;18(5):224-30.

60. Hussain A, Barer D. Rehabilitation after hip fracture. *Age Ageing* 1995;24(5):454.

61. Stineman MG, Goin JE, Granger CV, Fiedler R, Williams SV. Discharge motor FIM-function related groups. *Arch Phys Med Rehabil* 1997;78(9):980-5.

62. American Heart Association. *2002 Heart and Stroke Statistical Update*. Dallas, TX: American Heart Association; 2001.

63. Horner RD, Matchar DB, Divine GW, Feussner JR. Racial variations in ischemic stroke-related physical and functional impairments. *Stroke* 1991;22(12):1497-501.

64. Jorgensen HS, Nakayama H, Raaschou HO, Vive-Larsen J, Stoier M, Olsen TS. Outcome and time course of recovery in stroke. Part II: Time course of recovery. The Copenhagen Stroke Study. *Arch Phys Med Rehabil* 1995;76(5):406-12.

65. Jorgensen HS, Nakayama H, Raaschou HO, Vive-Larsen J, Stoier M, Olsen TS. Outcome and time course of recovery in stroke. Part I: Outcome. The Copenhagen Stroke Study. *Arch Phys Med Rehabil* 1995;76(5):399-405.

66. Gresham GE, Phillips TF, Wolf PA, McNamara PM, Kannel WB, Dawber TR. Epidemiologic profile of long-term stroke disability: the Framingham study. *Arch Phys Med Rehabil* 1979;60(11):487-91.

REFERENCES (cont'd)

67. Ahlsio B, Britton M, Murray V, Theorell T. Disablement and quality of life after stroke. *Stroke* 1984;15(5):886-90.

68. Dombovy ML, Basford JR, Whisnant JP, Bergstrahl EJ. Disability and use of rehabilitation services following stroke in Rochester, Minnesota, 1975-1979. *Stroke* 1987;18(5):830-6.

69. Kotila M, Waltimo O, Niemi ML, Laaksonen R, Lempinen M. The profile of recovery from stroke and factors influencing outcome. *Stroke* 1984;15(6):1039-44.

70. Johnston M, Kirshblum S, Zorowitz R, Shiflett S. Prediction of outcomes following rehabilitation of stroke patients. *NeuroRehabil* 1992;2(4):72-97.

71. Chae J, Zorowitz R, Johnston M. Functional outcome of hemorrhagic and non-hemorrhagic stroke patients after in-patient rehabilitation. *Am J Phys Med Rehabil* 1996;75(3):177-82.

72. Hayes SH, Carroll SR. Early intervention care in the acute stroke patient. *Arch Phys Med Rehabil* 1986;67(5):319-21.

73. Novack TA, Satterfield WT, Lyons K, Kolski G, Hackmeyer L, Connor M. Stroke onset and rehabilitation: time lag as a factor in treatment outcome. *Arch Phys Med Rehabil* 1984;65(6):316-9.

74. Shah S, Vanclay F, Cooper B. Predicting discharge status at commencement of stroke rehabilitation. *Stroke* 1989;20(6):766-9.

75. DeJong G, Branch LG. Predicting the stroke patient's ability to live independently. *Stroke* 1982;13(5):648-55.

76. Kelly-Hayes M, Wolf PA, Kannel WB, Sytkowski P, D'Agostino RB, Gresham GE. Factors influencing survival and need for institutionalization following stroke: the Framingham Study. *Arch Phys Med Rehabil* 1988;69(6):415-8.

77. Sacco RL, Hauser WA, Mohr JP, Foulkes MA. One-year outcome after cerebral infarction in whites, blacks, and Hispanics. *Stroke* 1991;22(3):305-11.

78. Goldstein C, Hoenig H. Stroke rehabilitation in African American patients. In: Gillum R, Gorelick P, editors. *Stroke in Blacks*. Basel: Karger; 1999. p. 198-209.

REFERENCES (cont'd)

79. Wheatley B, DeJong G, Sutton J. Managed care and the transformation of the medical rehabilitation industry. *Health Care Manage Rev* 1997;22(3):25-39.

80. Hughes RG, Garnick DW, Luft HS, McPhee SJ, Hunt SS. Hospital volume and patient outcomes. The case of hip fracture patients. *Med Care* 1988;26(11):1057-67.

81. *Getting Started with the Uniform Data System for Medical Rehabilitation.* Buffalo, NY: State University of New York at Buffalo; 1996.

82. *Guide to the Uniform Data System for Medical Rehabilitation (Version 5.0).* Buffalo, NY: State University of New York at Buffalo; 1996.

83. Fiedler RC, Granger CV. Uniform data system for medical rehabilitation: report of first admissions for 1996. *Am J Phys Med Rehabil* 1998;77(1):69-75.

84. Iwanenko W, Fiedler RC, Granger CV. Uniform Data System for Medical Rehabilitation: report of first admissions to subacute rehabilitation for 1995, 1996 and 1997. *Am J Phys Med Rehabil* 1999;78(4):384-8.

85. Leon J, Cheng M, Dunbar J. Trends in Special Care: *The 1995 National Nursing Home Census of Sub-Acute Units.* Washington, D.C.: Project Hope Center for Health Affairs for the U.S. Department of Health and Human Services, Office of Disability, Aging and Long-Term Care Policy; 1997.

86. Rhoads J, Krauss N. *Nursing Home Trends, 1987 and 1996.* Rockville, MD: Agency on Health Care Policy and Research; 1999.

87. Hamilton BB, Laughlin JA, Fiedler RC, Granger CV. Interrater reliability of the 7-level Functional Independence Measure (FIM). *Scand J Rehabil Med* 1994;26(3):115-9.

88. Stineman MG, Shea JA, Jette A, Tassoni CJ, Ottenbacher KJ, Fiedler R, et al. The Functional Independence Measure: tests of scaling assumptions, structure, and reliability across 20 diverse impairment categories. *Arch Phys Med Rehabil* 1996;77(11):1101-8.

89. Ottenbacher KJ, Hsu Y, Granger CV, Fiedler RC. The reliability of the functional independence measure: a quantitative review. *Arch Phys Med Rehabil* 1996;77(12):1226-32.

REFERENCES (cont'd)

90. Buchanan J, Andres P, Haley S, Paddock S, Young D, Zaslavsky A. *Final Report on Assessment Instruments for PPS*. Boston, MA: Harvard Medical School; 2002.

91. Hamilton B, Granger C, Sherwin F, Zielezny M, Tashman J. A Uniform Data System for Medical Rehabilitation. In: Fuhrer M, editor. *Rehabilitation Outcomes: Analysis and Measurement*. Baltimore, MD: Brookes; 1987. p. 137-47.

92. Kidd D, Stewart G, Baldry J, Johnson J, Rossiter D, Petruckevitch A, et al. The Functional Independence Measure: a comparative validity and reliability study. *Disabil Rehabil* 1995;17(1):10-4.

93. Roth E, Davidoff G, Haughton J, Ardner M. Functional assessment in spinal cord injury: a comparison of the Modified Barthel Index and the 'adapted' Functional Independence Measure. *Clinical Rehabilitation* 1990;4:277-85.

94. Granger CV, Cotter AC, Hamilton BB, Fiedler RC, Hens MM. Functional assessment scales: a study of persons with multiple sclerosis. *Arch Phys Med Rehabil* 1990;71(11):870-5.

95. Granger CV, Cotter AC, Hamilton BB, Fiedler RC. Functional assessment scales: a study of persons after stroke. *Arch Phys Med Rehabil* 1993;74(2):133-8.

96. Granger CV, Divan N, Fiedler RC. Functional assessment scales. A study of persons after traumatic brain injury. *Am J Phys Med Rehabil* 1995;74(2):107-13.

97. Disler PB, Roy CW, Smith BP. Predicting hours of care needed. *Arch Phys Med Rehabil* 1993;74(2):139-43.

98. Stineman MG, Escarce JJ, Goin JE, Hamilton BB, Granger CV, Williams SV. A case-mix classification system for medical rehabilitation. *Med Care* 1994;32(4):366-79.

99. Stineman MG, Tassoni CJ, Escarce JJ, Goin JE, Granger CV, Fiedler RC, et al. Development of function-related groups version 2.0: a classification system for medical rehabilitation. *Health Serv Res* 1997;32(4):529-48.

100. Granger CV, Hamilton BB, Fiedler RC. Discharge outcome after stroke rehabilitation. *Stroke* 1992;23(7):978-82.

101. Area Resource File. http://www.arfsys.com. Accessed on March 1, 2003.

REFERENCES (cont'd)

102. MapInfo Inc. http://www.mapinfo.com. Accessed on March 1, 2003.

103. Carter GM, Relles DA, Buchanan JL, Bean D, Donyo T, Rosenfeld K, et al. *A Patient Classification System for Inpatient Rehabilitation Patients: A Review and Proposed Revisions to the FIM-FRGs.* Santa Monica, CA: RAND Corp.; 1997.

104. Bell R, Keesey J, Richards T. The urge to merge: linking vital statistics records and Medicaid claims. *Medical Care* 1994;32(10):1004-18.

105. Jaro MA. Probabilistic linkage of large public health data files. *Stat Med* 1995;14(5-7):491-8.

106. Roos L, Wajda A. Record linkage strategies. *Methods of Information in Medicine* 1991;30:117-23.

107. U.S. Department of Health and Human Services PHS, Health Care Financing Administration. *International Classification of Diseases 9th Revision Clinical Modification*; 1989.

108. Newton R, Rudestam K. *Your Statistical Consultant: Answers to Your Data Analysis Questions.* Thousand Oaks, CA: SAGE Publications; 1999.

109. Dawson-Saunders B, Trapp R. *Basic and Clinical Biostatistics.* 2nd ed. Norwalk, CT: Appleton & Lange; 1994.

110. Afifi A, Clark V. *Computer-Aided Multivariate Analysis.* 3rd edition ed. Boca Raton, FL: Chapman & Hall/CRC; 1999.

111. Kleinbaum D, Kupper L, Muller K. *Applied Regression Analysis and Other Multivariable Methods.* Boston, MA: PWS-Kent Publishing Company; 1988.

112. Kleinbaum D, Kupper L, Morgenstern H. *Epidemiologic Research.* New York: Van Nostrand Reinhold; 1982.

113. Glantz S, Slinker B. *Primer of Applied Regression and Analysis of Variance.* second ed. New York: McGraw-Hill, Inc.; 2001.

114. Rothman K. *Epidemiology: An Introduction.* NY: Oxford University Press; 2002.

REFERENCES (cont'd)

115. Kane RL, Chen Q, Finch M, Blewett L, Burns R, Moskowitz M. The optimal outcomes of post-hospital care under Medicare. *Health Serv Res* 2000;35(3):615-61.

116. Reker D, Rosen A, Hoenig H, Berlowitz D, Laughlin J, Anderson L, et al. The hazards of stroke case selection using administrative data. *Med Care* 2002;40(2):96-104.

117. Cammack S, Eisenberg M. *Key Words in Physical Rehabilitation*. New York: Springer; 1995.

118. Timmreck T. *Health Services Cyclopedic Dictionary: A Compendium of Health Care and Public Health Terminology*. 3rd ed. Sudbury, MA: Jones and Bartlett Publishers; 1997.

119. Katz J, Green E. *Managing Quality: A Guide to System-Wide Performance Management in Health Care*. 2nd ed. St. Louis, MO: Mosby; 1997.

120. Last J. *A Dictionary of Epidemiology*. 4th edition ed. New York: Oxford University Press; 2001.

121. *Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing and Allied Health*. 6th ed. St. Paul, MN: Tringa; 1997.

122. U.S. Department of Health and Human Services HCFA. Medicare Program; Prospective Payment System for Inpatient Rehabilitation Facilities; Proposed Rule. Federal Register 2000;65(214):66304-442.

123. U.S. Department of Health and Human Services HCFA. Medicare Program; Changes to the Hospital Inpatient Prospective Payment Systems and Fiscal Year 1997 Rates. *Federal Register* 1996;61(170):46165.

Quality Bookbinding
Since 1945
Bound by
THE A & H BINDERY
Chicago, Illinois
(312) 421-6900

CMS LIBRARY
3 8095 00003938 4